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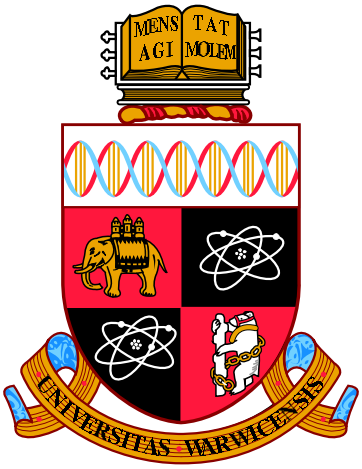

Insider Trading around Earnings Announcements: Implications for Information Dissemination in Financial Markets

by

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Thesis

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Declarations

I declare that any material contained in this thesis has not been submitted for a degree to any other university. I further declare that Chapter 1 is co-authored with Dr. Jana Fidrmuc and Dr. Jiří Novák, and Chapters 2 and 3 are co-authored with Dr. Jana Fidrmuc.

Harold Contreras

January 2017

Abstract

The aim of this thesis is to contribute to the literature in finance and economics providing a deeper understanding about insider trading and its effects over information dissemination in the financial markets. To this end, this thesis is organized in three chapters.

The first chapter tests whether insiders exploit their stock's mispricing after earnings announcements to make profitable trades. The analysis involves estimating a model of 'normal' market reaction to an earnings announcement and use the deviation of the fitted value from the realized market reaction as a measure of mispricing after earnings announcements. In line with the mispricing hypothesis, the results show that insiders sell (buy) more often after large positive (negative) values of our mispricing measure and earn significant post trading returns.

The second chapter extends the analysis in the first chapter by exploring more deeply the source of that mispricing. Focusing on insider sales, this chapter studies whether insiders exploit investors' sentiment during earnings announcements to make profitable trades. In line with Miller (1977) model, the results show that insiders sell in response to market reaction of earnings announcements that are associated with an increase in divergence in investors' opinions about their firms' valuation and more binding short sale constraints.

Finally, the third chapter studies the interaction between 2 types of informed investors, insiders and short sellers, during earnings announcements. The chapter documents that insiders and short sellers are skilled information processors who compete for trading on the news released at earnings announcements. In line with competition, stock returns are significantly more negative faster for stocks with intensive trading by both traders together than in cases where they trade intensively alone. The evidence suggests that insiders and short sellers tend to accelerate their processing skills after earnings announcements and trade faster making stock prices more efficient.

Introduction

Corporate insiders, that is, officers, directors or beneficial owners of publicly traded companies are usually considered informed investors as they have access to private information about their firms. Insiders know their companies better than any analyst in the market and, therefore, their trades are very controversial. In fact, insider trading is commonly associated to an illegal activity when is heard, but insider trading is any transaction (purchase or sale) made by a corporate insider on the shares of her company's stocks. In the U.S. insider trading is regulated by Security Exchange Commission (SEC) who oblige insiders to report their transactions by filling forms 3, 4 or 5 specified by the Security Exchange Act of 1934. The SEC define illegal insider trading as those transactions that are carried out in possession of non-public material information. As this definition is very broad, detecting illegal insider trading is not an easy task. The SEC must demonstrates that a person "trades a security while in possession of material non-public information in violation of a duty to withhold the information or refrain from trading".[1] Cases of illegal insider trading are abundant, from the famous case of Texas Gulf Sulphur Company in the 60's (Manne, 1966) to more recent ones as the Galleon Group (the largest

[1]From the U.S. Securities and Exchange Commission website: http://www.sec.gov/about/whatwedo.shtml#intro.

hedge fund insider trading case in U.S. history) in late 2009 (Cohen et al., 2012).

Should then insider transactions be allowed? This question has generated a large debate in recent years as it remains unclear how beneficial these transactions are for the stock markets. The main argument in favor of permitting unregulated insider trading is that it improves market efficiency. Early theoretical studies show that insider trading helps to incorporate private information into stock prices increasing informational efficiency of the market (Manne, 1966; Carlton and Fischel, 1983). More efficient stock prices are a desirable feature for a capital market as they reduce the informational asymmetry between firms' future performance and prospective investors (Myers and Majluf, 1984). In a efficient capital market, stock prices serve as a signal conveying information to outside investors who are willing to invests their capital on attractive companies. Therefore, the better the quality of the signals, the better is the allocation of resources in the market.

Nevertheless, other studies refute the association between insider trading and more efficient stock markets. This stream of the literature argues that insider transactions could crowd out information collection from outside investors deterring efficiency of stock markets (Fishman and Hagerty, 1992). Under this view, insider trades may discourage market professionals from acquiring information and trade in stocks, reducing the amount of information conveyed into stock prices. In line with this argument, Fernandes and Ferreira (2009) show that in countries with better Corporate Governance systems, once insiders are barred from trading, the efficiency of the capital market increases. That is, prices reflect more firm's true value when insiders are more restricted from trading.

Not surprisingly, the widespread interest in insider trading has spawned a large empirical literature trying to determine whether insiders trade on material non-public information and whether their trades convey new information to the market. Early evidence agrees that insiders possess superior information and outperform the market in their transactions (Jaffe, 1974; Finnerty, 1976; Seyhun, 1986, 1998; Lin and Howe, 1990; Pope et al., 1990; Rozeff and Zaman, 1998; Lakonishok and Lee, 2001; Jeng et al., 2003). Broadly speaking, these studies show a strong market reaction to the announcement of insider trading and future return predictability, which is attributed as a signal that insider transactions convey information to investors. Although, these papers show that insiders seem to correctly anticipate the direction in which prices move afterwards, they do not permit to distinguish whether insiders use valid inside information when trading or not.

The source of insiders information when trading has also generated debate in the literature. Wide consensus exists that insiders behave as contrarians, which means that they are more likely to sell their shares after periods of high stock returns and buy after periods of low stock returns (Rozeff and Zaman, 1998; Seyhun, 1998; Lakonishok and Lee, 2001; Piotroski and Roulstone, 2005). However, the literature is split in explaining the nature of this contrarian behavior of insiders. On the one hand, insiders use their superior inside information about their firms cash flows and trade on future reversals of their firms performance (Noe, 1999; Ke et al., 2003; Piotroski and Roulstone, 2005; Cheng et al., 2007). On the other hand, they do not use much valid inside information other than the one is publicly available. In this view, insiders time very well their transactions and trade when their stocks are mispriced by the market (Sivakumar and Waymire, 1994; Rozeff and Zaman, 1998; Jenter,

2005).

Do insider trading conveys new information to the market making stock prices more efficient? If so, which set of information do insiders use when trading? Is it non-public material information or publicly available information? This thesis addresses these and other questions. So far most of the literature focus on trading decisions by insiders on private information. This research explores an alternative hypothesis for insiders' superior trading advantage: Corporate insiders are skillful interpreting the information released in public news announcements. In particular, the thesis studies insider trading decisions in the context of earnings announcements. The setup is chosen following recent evidence that insiders trade mainly around important corporate events and mostly around earnings news (Ke et al., 2003). Specifically, they tend to trade right after quarterly earnings announcement or several months before, because they try to minimize legal jeopardy (Huddart et al., 2007; Kallunki et al., 2009). This setup allows to clearly identify how insiders interact with new information when is made public and how their trading decisions affects information dissemination in the stock market.

The thesis is split in 3 chapters. The first chapter studies whether insiders exploit their stock's mispricing after earnings announcements to make profitable trades. It shows that insiders trade more often after larger mispricing and earn significant post trading returns, suggesting that insiders do not use much valid inside information in their trades. The second chapter is very related to the first. However, while the first chapter establishes insider trading on mispricing after earnings announcements, the second explores more deeply the source of that mispricing. Focusing on insider sales, this chapter explores whether insiders exploit investors' sentiment during earnings

announcements to make profitable trades. In line with Miller (1977) model, the results show that insiders sell in response to market reaction of earnings announcements that are associated with an increase in divergence in investors' opinions about their firms' valuation and more binding short sale constraints. Finally, the third chapter analyzes the interaction between insiders and short sellers around earnings announcements. Both are considered to be informed traders in the literature and, therefore, studying their trading strategies and how their trades affects information dissemination in the stock market is very relevant. The results of this chapter suggest that insiders and short sellers are skilled information processors who compete for trading on publicly available information. In line with competition, stock returns are significantly more negative faster for stocks with intensive trading by both traders together than in cases where they trade alone.

Chapter 1

Do insiders trade on mispricing after earnings announcements?

Insider trading is not random. If we look at distribution of insider trading activity across quarters, that are defined as periods between two earnings announcements for all listed US firms over 2003-2009, we see obvious patterns. First, insider purchases and sales across individual insiders within the same firm tend to cluster in particular quarters: majority of quarters with insider sales contain only insider sales and quarters with purchases contain only purchases. Only 5% of all quarters contain both insider purchases and sales.[1] Second, insider trading also exhibits serial auto-correlation: 58% of all quarters with insider sales are followed by another quarter with insider sales while 32% of quarters with insider purchases are followed by another quarter with insider purchases. These patterns suggest consistency in opinion among insiders. Insiders seem to agree when it is time to sell, purchase or not to trade at all.

[1]Note that 58% of quarters do not contain any insider transactions.

If insider trading is not random, what are then the trading rules they follow? This chapter shows that insiders of U.S. publicly listed companies are able to identify situations when their stock is mispriced after earnings announcements and following their trading leads to abnormal future returns. In particular, insiders tend to sell their stock after earnings announcements when the stock price is high relatively to their perception of fundamental firm value and buy stock when the current stock price is too low. These findings are in line with recent evidence on attentive insider trading (Alldredge and Cicero, 2015) that argues that insiders are attentive to interpreting new public information and tend to take advantage of situations when the market misinterprets the news. Given stringent U.S. insider trading regulation and high legal jeopardy, insiders are often trading immediately after releases of price sensitive information rather than before (Huddart et al., 2007). Use of information after it was publicly released provides higher protection against legal jeopardy, but attentive insiders might still interpret the published information differently to the market. Better information processing and interpretation skills as well as intimate and deep knowledge of their firms provides insiders with an advantage even after earnings news is released to the public domain. Engelberg et al. (2012) show evidence that also short sellers profit on their superior information processing skills after news announcements.

In a broad sense, this chapter revisits the question posed by Piotroski and Roulstone (2005) on whether insiders trade on market pricing errors or rather on their superior foreknowledge of future cash flows. This question is of profound interest for both regulators and financial economists. The former are profoundly interested in the effectiveness of restrictions concerning trading on material information, which could potentially disadvantage other (uninformed)

market participants, discourage stock trading and harm market liquidity (Fishman and Hagerty, 1992; Leland, 1992). The latter are interested in the wide process of information revelation in the stock market and stock price efficiency and, therefore, in the question of how dealings of insiders in the stocks of their own firms affect this process.

Piotroski and Roulstone (2005) show that the insider purchase ratio is both positively related to the firm's future earnings performance and inversely related to recent returns (and positively related to book to market ratio). Each relation has incremental explanatory power. However, Piotroski and Roulstone (2005) conclude that information about future cash flow changes explains a smaller portion of insider purchases than recent returns or book to market ratio. We extend Piotroski and Roulstone (2005) in three important ways. First, even though Piotroski and Roulstone (2005) mainly focus on a horse race between '[insiders] trading against current investor sentiment (i.e., by trading with less bias and/or better models than outside investors) and trading on the basis of superior cash flow information' (page 57), they only show that insiders are contrarians but not that insiders actually trade on mispricing. They show that yearly insiders' purchases are placed against recent stock returns and in line with book to market ratio. However, selling (buying) when recent returns are high (low) versus recognizing moments when the stock price is too high relatively to the fundamental firm value is not the same. Contrarian trading purely based on recent stock returns (or book to market ratio) is mechanistic and is not able to distinguish cases when stock price is rightly high because future firm prospects improved significantly nor cases when a firm is indeed overpriced even though recent stock returns are very low (the stock return should be even lower and, thus, the market has under-reacted to bad news).

In other words, showing that insiders trade against recent stock returns is consistent with insiders trading on mispricing of their stock, but does not validate the hypothesis of mispricing. A valid test would benchmark against a measure of insiders' own valuation of the firm's fundamental value. The set-up of analyzing insider trading after earnings announcements allows us to address this weakness.

Second, measuring insider trading relatively to earnings announcements has also an advantage of more precise measurement of future stock returns, which are essential as supporting evidence for insider trading on mispricing. Brown and Warner (1980) highlight the importance of precise knowledge of event dates for the power of abnormal return tests. The well defined time structure around earnings announcements means that post trading abnormal returns are estimated with high precision and their tests exhibit high power. Indeed, our future stock return analysis provides strong supportive evidence, which is in contrast to Piotroski and Roulstone (2005) but also to Jenter (2005).

Third, our sample covers a period of stricter regulation after adoption of the Sarbanes-Oxley Act of 2002 that requires insiders to report their trades within two business days and imposes higher penalties for trading on material information (Brochet, 2010). Naturally this change in legislation relatively to the pre-SOX sample in Piotroski and Roulstone (2005) would affect the horse race between trading on different interpretation of public information (attentive insider trading) versus trading on private information of future cash flows.

We design two sets of tests that in our view provide supporting evidence that insiders trade on deviations of stock valuations from their perceptions of fundamental firm values after earnings announcements. The first set of tests

is designed to show that insiders do not trade purely contrary to earnings announcement news. A simple contrarian trading strategy predicts positive future returns when going long in poorly performing stock (with negative earnings announcement market reaction) and going short in good performing stock (with high earnings announcement market reaction).[2] On U.S. insider trading data over 2003-2009, we show that insider transactions that follow this simple contrarian trading strategy are indeed profitable. However, insiders trade profitably also when selling stocks with negative earnings announcement abnormal returns and buying stock with positive earnings announcement abnormal returns.[3] They trade on market overreaction to good news but also on market underreaction to bad news. Thus, they trade profitably after earnings announcement price adjustments regardless of the direction of the earnings news. In our view, these results suggest that insiders are able to recognize when the market over- or under-reacts to earnings disclosures and profit on price reversals as the stock then adjusts back to the fundamental value.

The second set of tests involves a direct estimation of mispricing associated with an earnings announcement. The design of these tests takes advantage of useful properties of earnings announcements. Earnings announcements are regular and frequent and insiders tend to trade closely after the announcements. Also, earnings surprises are important information events that capture the attention of investors due to pervasive discussion of firm's earnings news in financial media (Barber and Odean, 2008; Brown et al., 2009) and, therefore, are associated with significant stock price movements. Engelberg et al.

[2]Sivakumar and Waymire (1994) and Garfinkel (1997) show that insiders are likely to sell after positive earnings announcements and buy after negative earnings announcements, which is consistent with contrarian trading patterns.

[3]Insiders follow both contrarian and momentum trading, but selectively.

(2015) argue that mispricing gets more pronounced around news announcements. Furthermore, measures of the actual market reaction to the earnings announcements are quite well established in the literature and, so, designing a measure of mispricing is then relatively easier in this well-defined environment. We estimate a 'normal' market reaction to earnings news and then take the deviation of the realized market reaction from the fitted value as a measure of mispricing. We take the 'normal' market reaction, or fitted earnings announcement abnormal return, as a proxy for the fair stock price adjustment after an earnings announcement that reflects the fundamental firm value. As managers are closely associated with the day-to-day operations of their firms, it is reasonable to assume that the fitted value is also close to the managers' perception of the fundamental firm value.[4] In line with the mispricing hypothesis, insiders tend to sell after large positive deviations of this variable while they tend to buy after large negative deviations. At the same time, following Piotroski and Roulstone (2005), we assume that realized future earnings innovations represent unbiased proxies of future cash flow changes that are unexpected by the market participants but known by the insiders at the time of their trade. The results suggest that the odds of insider trading are not significantly associated with future earnings innovations. This result is very persistent for both purchases and sales and is line with a change towards more stringent insider trading regulation after SOX. Importantly, Jensen's alphas estimated on future returns indicate high profitability of insider purchases and sales of mispriced firms.

To summarize, our results confirm effectiveness of current insider trading regulations where insiders are encouraged to trade after rather than before pub-

[4]I further justify this measure in section 1.3.

lic announcement of important corporate news such as quarterly earnings and strongly discouraged to trade on material information. Not only do insiders' trades concentrate in the period immediately after earnings announcements, but also, and perhaps more importantly, the odds of insiders selling (buying) are not associated with future negative (positive) earnings or earnings innovations. Rather, they are strongly associated with positive (negative) stock price deviations from fundamental firm value. Insiders do not seem to trade on foreknowledge of future earnings, but rather on different interpretation of newly released public information. Their attentive interpretation of public information and trading when their view differs from the prevailing market consensus, which is reflected in the stock price, should eventually contribute to stock prices better reflecting fundamental valuations and, therefore, higher price efficiency.

Our analysis is also closely related to Jenter (2005), Kolasinski and Li (2010) and to some extent to Veenman (2012). Jenter (2005) also explores the idea that managers' perceptions of fundamental value often diverge from market valuations. However, he focusses on testing 'the hypothesis that managers perceive their own stock as misvalued when making corporate decisions' and uses 'managers' own portfolio trades as a window into their beliefs' (page 1904).[5] Therefore, Jenter (2005) takes trading in the personal portfolio as a strong and direct indicator of whether managers view their company stock as mispriced, but does not provide any direct evidence supporting the conjecture in excess to showing that insiders have contrarian views. He is neither able to show any

[5]The idea of insiders recognizing mispricings of their stock and attempting to take advantage of it through their corporate decisions has been advanced in the literature, for example through equity issues, repurchases or takeovers (Ritter, 1991; Ikenberry et al., 1995; Shleifer and Vishny, 2003).

significant future returns consistent with the conjecture. In contrast, we focus directly on insider trading associated with deviations from fundamental firm values and show strong future abnormal stock returns.

The main difference to Kolasinski and Li (2010) is that we analyze insider trading association with any mispricing, while they choose to focus on a subset of insider purchases and sales that follow after market underreacts to earnings information. Moreover, Kolasinski and Li (2010) do not directly estimate mispricing associated with earnings announcements and, therefore, are only able to show that net insider purchases follow after positive market reaction to earnings announcement when earnings surprise is low. Veenman (2012) shows that insider purchases reported in Form 4 filings help investors learn about the valuation implications of past earnings signals. Our results suggest that this is because insiders' purchases follow those earnings announcements when insiders disagree with the market's original interpretation of the earnings information. Insiders buy after earnings announcements when the market reaction to the earnings announcement is in their view too negative. Following Form 4 filings, investors adjust initial pricing errors.

The rest of the chapter is organized as follows. Section 1.1 describes the data set. Sections 1.2 and 1.3 present our results concerning post insider trading abnormal returns and using our estimated measure for mispricing, respectively. Section 1.4 concludes.

1.1 Data

Our sample of US corporate insider trades is from the Thomson Financial Insider Filing Data, which contains trades by corporate insiders required to be

filed via Form 4 by Section 16 of the Securities Exchange Act of 1934. Insiders required to fill in the form are company officers (executives), directors (non-executive members of the board), and beneficial owners of more than 10% of the company stock. We start our data set as of January 2003 to include only insider transactions that are reported under the more timely new rules of the Sarbanes-Oxley Act of 2002. The last year covered is 2009. We have information on the trading date, the reporting (announcement) date, the firm id, the insider and their position within the firm, the number of shares traded, the transaction price and the direction of the trade (purchase or sale). We exclude from our data set owners of more than 10% of the company stock. We merge all transactions within one day of the same director in the same direction (purchases/sales), but we keep transactions if in different direction even on the same day. At this stage, we do not merge transactions over different directors. All together we have 79,630 individual insider-day purchases and 212,491 individual insider-day sales for 6,494 firms.

Our analysis is built around earnings announcements that are together with other accounting information downloaded from COMPUSTAT. Figure 1.1 shows our setup, timings and notation. For each quarter, we denote the two earnings announcements at the beginning and end of the quarter as EA_0 and EA_1, respectively. The numbering of earnings announcements then goes up from EA_1 to the future and down from EA_0 to the past. Accordingly, the fourth earnings announcement after the quarter when insider trading is measured is denoted EA_4 as the first one is EA_1. Thus, the period between two earnings announcements (for example EA_0 and EA_1) is a quarter and we aggregate all insider transactions on this quarterly level. Our data set includes all firm-quarters with data available in COMPUSTAT. Stock and market returns

are downloaded from CRSP and the benchmarks for size and B/M portfolio returns are downloaded from Kenneth French's web page. All together, over the period from the beginning of 2003 to the end of 2009, we have data on 132,334 firm-quarters for 5,232 firms. We classify each firm-quarter as one of the following types: (i) without any insider trading, (ii) containing only insider purchases, (iii) containing only insider sales and (iv) containing both insider purchases and sales. We label them no insider trading quarters, insider sale quarters, insider purchase quarters and mix quarters, respectively.

Insert Figure 1.1 about here.

Table 1.1 shows the main frequencies and statistics. In Panel A we see that all together, insiders decide not to trade in 57.6% of all firm-quarters in our data set. This in turn means that 42.4% of quarters have at least one insider trading transaction. Insider sales are more frequent relatively to purchases: 26.9% of quarters contain only sales versus 10% contain only purchases. Quarters with a mix of insider purchases and sales are quite rare (5.5%). The fact that insiders are more eager to sell than to buy is also documented when looking at the average per quarter of the number of transactions and total number of shares traded as a fraction of all shares outstanding.

Insert Table 1.1 about here.

Panel B of Table 1.1 shows that insiders do not only agree to buy and sell in the same quarters, but purchase and sale quarters are also clustered together over time. All the quarters in Panel B are partitioned conditional on insider trading in the previous quarter. We see important time dependence: 'No trade' in a quarter is significantly more likely in case there was no trading also

the previous quarter. Similarly, purchases are more likely following a quarter with purchases and sales following a quarter with sales. Another interesting observation is that mix quarters seem to be transient: both quarters with purchases and sales are more likely to follow after a mix quarter rather than a quarter without any insider trading.

Table 1.2 provides summary statistics for earnings announcements and abnormal returns. In Panel A, we see that the overall average return on assets (ROA) corresponding to all earnings announcements is –0.06 and the earnings per share adjusted by the earnings per share in the same quarter 1 year ago and scaled by the stock price (EPS) is –.02.[6] On average, each firm has 7 analyst earnings forecasts. We subtract the mean analyst forecast from the EPS to get the unexpected element of the earnings announcement and scale the difference by the stock price. The unexpected earnings (UE) are still negative, but substantially smaller at –0.005. One should also note the significant drop in observations because analysts do not tend to cover smaller firms.

Insert Table 1.2 about here.

The last part of Panel A of Table 1.2 provides information on the size and book to market ratio of firms in our sample. The average firm has a market capitalization of USD2,426 million. To put this number into perspective, we also compute the size quintile based on the NYSE break points as reported in the Kenneth French's web page. Each firm-quarter is assigned into quintile 0 to 4, where 0 is the smallest size quintile and 4 is the largest. The quintile average of 0.93 suggests that our firms are relatively small. The average book to market ratio is 0.63 and the average B/M quintile is 1.65 showing that the

[6]The low average values are due to very low values during the financial crisis.

average firm in our data set is on the growth side of the spectrum of NYSE firms that define the break points.

Panel B of Table 1.2 shows the abnormal returns for all firm-quarters in our data set as well as for insider sale, insider purchase and mix quarters, respectively. Due to our setup we report abnormal returns relatively to the 2 earnings announcements at the beginning and end of the quarter in which me measure insider trading (EA_0 and EA_1). All abnormal returns in Table 1.2 are computed as buy and hold returns that are adjusted for the return on the corresponding 5x5 size and book to market portfolio as downloaded from the Kenneth French's web page. The earnings announcement abnormal returns are computed over the 3 days surrounding the earnings announcements. The past abnormal returns include the EA_0 announcement effect and so end 1 day after EA_0. The post insider trading abnormal returns include the EA_1 announcement effect and start on day -1 relatively to EA_1.

Panel B shows that, as expected, the average return pattern depends strongly on insider trading. For example, the overall EA_0 announcement effect is small and insignificant in column 1 with the unconditional average, but significantly positive for insider sale quarters and significantly negative for purchase quarters. It confirms findings in the literature that insiders are on average contrarian traders (Sivakumar and Waymire, 1994; Garfinkel, 1997). Past returns confirm the contrarian nature of insider trading over longer horizons (Piotroski and Roulstone, 2005; Jenter, 2005). In contrast to EA_0, the announcement effect for EA_1 is statistically insignificant and economically small indicating that insiders do not trade opportunistically just before earnings announcements. Post trading returns for insider purchases are significantly positive and economically large. Even though the returns for sales are not significant over 3

and 6 months, they are still the smallest across the partitions. The returns for mix quarters show that the special category is justified: mix quarters differ from sale as well as purchase quarters.

1.2 Post trading returns

In this section we explore patterns of post insider trading abnormal returns to show that insiders do not trade purely in contrarian fashion to earnings announcement news but rather on deviations of stock prices from fundamental firm value. A simple contrarian trading strategy that follows earnings announcements would suggest that insiders sell after positive news and buy after negative news and it should be the 'sell after positive news' and 'buy after negative news' that are profitable.[7] In contrast, trading on mispricing of stock should not depend on the direction of earnings news, that is on whether the market reaction to the earnings announcement is positive or negative. Insiders should be able to recognize over-pricing and sell both when market over-reacts to positive news as well as when market under-reacts to negative news. Similarly, if insiders buy on under-pricing, they should react to both market under-reaction to good news and market over-reaction to bad news. As a result, if insiders trade on mispricing, we should observe that their trading is profitable both after positive and negative news. A simple contrarian trading strategy, in contrast, predicts significant returns only for selling after good news and buying after bad news.

Table 1.3 shows average post insider trading abnormal returns over 1, 3, 6 and 12-months starting one day before EA_1 (as shown in Figure 3.1) that

[7]Similarly, 'sell after negative news' and 'buy after positive news' should be profitable following a simple earnings momentum trading strategy.

are conditional on positive, no and negative news.[8] Partitioning by news is defined based on the 3-day EA_0 abnormal return terciles. We adjust for size and B/M portfolio returns in Panel A and equally weighted market returns in Panel B. First, in the last column in Panel A with frequency of quarters across the partitions we see that insiders sell and buy both after positive and negative news. Even though 39% of sales (12,586 out of all 32,013 sale quarters) follow after news in the highest news tercile (good news), still 26% of sales (8,394 quarters) follow after news in the lowest tercile (bad news). This is a significantly important fraction of all insider sale quarters. The fractions for purchases are very similar. Out of all 10,394 purchase quarters, 27% follow after good news and 43% after bad news.

Importantly, the future returns in Panel A show that insiders sell (buy) profitably both following good and bad news, which contradicts a simple contrarian trading strategy. Namely, abnormal returns in Panel A are consistently negative and significant after insider sales (–111 and –108 basis points at the 12-month horizon for good and bad news, respectively) and positive and significant after insider purchases (965 and 628 BP, respectively). Note that the post trading returns are a bit smaller (in absolute terms) for insider sales: for bad news they are significant only for the 12-month horizon. Post trading abnormal returns are much stronger in Panel B with market adjusted returns suggesting that insider sales in larger firms, where insiders are awarded more stocks and stock options and therefore have more shares to sell, are a bit less associated with mispricing and are perhaps more driven by liquidity or

[8] As we cumulate all insider trading over the current quarter, we start measuring post trading returns only at the end of the current quarter. At the same time, including the EA_1 announcement effect is quite essential. For brevity, we do not report abnormal returns for quarters with both insider purchases and sales. They are not different from returns reported for quarters without any insider trading.

diversification motives.[9]

Insert Table 1.3 about here.

In Panel A, we also report the cumulative EPS and cumulative UE over the 4 earnings announcements following the current quarter (EA_1 to EA_4 as in Figure 3.1). We see that quarters with insider purchases tend to have the most negative future earnings (and future unexpected earnings) while insider sale quarters are followed by the largest earnings. Future cumulative earnings when insiders are not trading are also significantly negative and smaller compared to sale quarters. This result seems to be inconsistent with insiders trading on foreknowledge of future cash flows. Future earnings following insider purchases versus sales should be larger rather than smaller for insiders to profit on foreknowledge of future earnings news.

As a second test to better identify the mispricing mechanism, we consider a quasi-experiment. Seyhun (1986) and Fidrmuc et al. (2006) suggest that insiders more familiar with the day-to-day operations of their firms should trade on more valuable information. Following this argument, we conjecture that the top executives, that is CEOs and CFOs, should be more attentive (Alldredge and Cicero, 2015) and better identify situations of mispricing. In Table 1.4, we report post insider trading abnormal returns as in Table 1.3 but now conditional on top executive trading for sale and purchase quarters. Again, we report abnormal returns adjusted for size and B/M in Panel A and for market returns in Panel B.

[9]Further unreported analysis confirms that insider sales after bad news in larger firms (top tercile by total assets) are not profitable while in smaller firms (lower 2 terciles by total assets) are associated with the average 6 and 12 month post trading returns of –134 and –246 basis points, both significant at the one-percent level. A similar size pattern prevails for sales after good news but not after no news.

Insert Table 1.4 about here.

Panel A of Table 1.4 shows that quarters with top executive sales deliver significantly more negative future abnormal returns (–60 and –123 BP over 6 and 12 months, respectively) relatively to quarters with sales of other insiders (insignificant over 6 and 12 months). Intuitively following the results in Table 1.3, the post trading returns conditional on top executives sales become even more negative with both good and bad news. They drop to –90 and –96 BP over 6 months and –198 and –220 BP over 12 months after good and bad news, respectively. Top executive sales are also quite profitable for intensive trading quarters, that is in quarters that fall into the top tercile by the relative fraction of all shares sold by insiders in the quarter to all shares outstanding. They earn 82, 122 and 222 BP over 3, 6 and 12 months following the quarter with their sales. Interestingly, the quarters with other insider selling, that are conditional on no CEO or CFO sale transactions, are not associated with significantly negative future returns. The results for top executive purchases are very similar in nature. Post trading returns are significantly larger for top executives relatively to other insiders and the differences are larger for quarters following both good and bad news and when insiders buy intensively.[10] The results in Panel B with market adjusted returns are even stronger for both top insider sales and purchases.

Our third test employs a regression framework that allows to implement multiple controls in a single model. Table 1.5 reports the regression results. In order to show that future returns are more negative (positive) after insider sales (purchases) that follow both after good and bad earnings news relatively

[10]Note that the average 6 and 12-month size and B/M adjusted abnormal return for no news is 290 and 787 BP, respectively, for top executives versus 218 and 638 BP, respectively, for other insiders.

to no insider trading, we regress the post trading abnormal returns for the horizons of 1, 3, 6 and 12 months adjusted for size and B/M portfolio returns on interaction terms between the sale and purchase quarter dummies and dummies for good, no and bad news.[11] Quarters without any insider trading is the reference category. We control for year fixed effects in all specifications and for cumulative EPS over the next 4 earnings announcements (EA_1 to EA_4) and size in Panel A and additionally for book to market ratio and past 12-month abnormal return in Panels B and C. In all specifications, we report the Hubert/White robust standard errors that are also clustered within firms.

The results in Panel A show that future returns are significantly more negative when insiders sell and positive when insiders buy and this is so both after good and bad earnings news. The coefficients for the interaction terms with insider sales (purchases) for good and bad news quarters are significantly negative (positive) for most of the monthly horizons, and higher in absolute terms relatively to the coefficient for no news. These results are significant even after controlling for firm size and potential insider foreknowledge of future cash flows (Future cumulative EPS). We consider controlling for future cumulative earnings very important as it shows that insiders' intuition for future earnings does not affect the results. In fact, inclusion of the future cumulative earnings makes the results somewhat stronger.

Insert Table 1.5 about here.

In Panel B, we control also for the book to market ratio and past 12-month returns, the 2 variables used in the literature to detect contrarian trading (Jenter, 2005; Piotroski and Roulstone, 2005). The coefficients for the 2 contrarian

[11] The partitions are again defined based on terciles by the market reaction to EA_0. We use a window of (–23, +1) to account for leakage of information before the earnings news.

variables have the predicted sign and are significant at the one-percent level for all horizons. Firms with low book to market ratio and high past returns deliver smaller future returns. As contrarian trading is based on selling of high value firms with positive past returns and buying low value firms with low past returns, if insiders rely on this type of trading strategy, our results should be weaker for sales after high positive earnings announcement returns (good news) and purchases after strong negative earnings announcement abnormal returns (bad news). We see this effect for sales. The coefficients for sales in Panel B are less negative for good news relatively to Panel A, which indicates that, indeed, after good news insiders sell more often higher value firms. This could be attributed to diversification and/or liquidity reasons for insider selling. However, the coefficients for sales after bad news still remain strong an contradict plain contrarian trading. The results for purchases are almost unaffected by inclusion of the book to market ratio and 12-month past returns.

Panel C considers trading by top executives versus other insiders. We extend the model in Panel B by replacing the interaction terms for sales and purchases (with good and bad news) by a richer set of interaction terms for sales and purchases of top executives and other insiders' sales and purchases. The results confirm that sales and purchases of top executives are more profitable. All the coefficients for top executive trading are larger in absolute terms relatively to the coefficients for other insiders except top sales after good news.[12] We also perform two sets of robustness checks without reporting the results: (i) we re-estimate all models using firm fixed effects; (ii) we use

[12]This is due to controlling for the book to market ratio and past returns that decrease the magnitude and significance of the sale after good news coefficients as discussed in Panel B above. It seems that top executives sell higher value firms when selling after good news.

the market adjusted abnormal returns. The results remain unchanged.

In summary, the analysis of future abnormal returns in this section indicates that insiders follow trading strategies that are more sophisticated than simple contrarian trading strategies. We show that insider sales and purchases are profitable, especially when insiders trade following strong market reaction to earnings news regardless of the sign of the earnings surprise. The results are consistent with insiders trading as a reaction to mispricings following earnings announcements.

1.3 Estimation of mispricing

In this section, we show a more direct evidence for our hypothesis of insider trading on mispricing after earnings announcements. To do so, we need to estimate the deviations of stock prices from the fundamental firm value and show that insiders tend to trade in line with the estimated pricing errors and make larger profits when they do so. In line with this idea, we model the 'normal' market reaction to earnings news and then estimate the 'excess' market reaction as the difference between the realized market reaction to an earnings announcement and the fitted value of the 'normal' market reaction. In the spirit of Hong et al. (2012), we predict the 'normal' market reaction to earnings news using the following model:

$$\begin{aligned} AR_{i,q} = \beta_0 + \beta_1 EPS_{i,q} + \beta_2 UE_{i,q} + \beta_3 NUMAN_{i,q} + \beta_4 PastAR_{i,q} \\ + \beta_5 MCAP_{i,q-1} + \beta_6 BM_{i,q-1} + \beta_7 VOL_{i,q-1} + \alpha_t + \alpha_i + \epsilon_{i,q} \end{aligned}$$

where $AR_{i,q}$ is the EA_0 3-day buy and hold abnormal return using the size and

B/M adjustment for firm i and quarter q, $EPS_{i,q}$ is the announced earnings per share seasonally adjusted for the EPS in quarter EA_{-4} and scaled by the closing stock price 2 days before the announcement date, $UE_{i,q}$ is the unexpected earnings or the difference between the announced EPS and the mean analyst forecast also scaled by the closing stock price 2 days before the announcement date, $NUMAN_{i,q}$ is the natural logarithm of one plus the number of analysts following the stock, $PastAR_{i,q}$ is the past 12-month abnormal return ending on day –2 relative to EA_0, $MCAP_{i,q-1}$ is the natural logarithm of the market capitalization one quarter lagged, $BM_{i,q-1}$ is the book to market ratio one quarter lagged, $VOL_{i,q-1}$ is the variance of stock returns over one month ending on day –24 relative to EA_0, α_t and α_i are the year and firm fixed effects.[13]

Using all firm-quarters in our data set, we estimate the coefficients of the model. The fitted values then represent 'normal' market reaction given the earnings news (EPS and UE) and controlling for other firm characteristics and time and firm fixed effects.[14] Consequently, the error terms represent the deviations of the actual market reaction to the earnings announcement from the predicted/fitted values. If the fitted values embody fair approximation of the fundamental effect of the earnings news, then deviations from this fair value should represent a reasonable proxy for pricing errors after earnings announcements. We also implicitly assume that the fitted value is a reasonable

[13]We adjust the model in Hong et al. (2012) in the following way: (i) we use a continuous variable for EPS and UE instead of a dummy variable for high earnings surprise, continuous variables for market capitalization, book to market ratio and volatility instead of 25 groups for size, price to earnings ratio and volatility, (ii) we use number of analysts following the firm instead of dispersion of analyst forecast to increase the size of the data set as dispersion is reliably estimated only for large firms with more than 3 analysts following the firm, (iii) we are not able to measure shortselling activity and presence of convertible debt, but these variables reflect the special purpose of the Hong et al. paper and are not needed for our purposes.

[14]We do not report the regression results, but all the explanatory variables are significant and with the expected sign.

approximation of insiders' estimation of the fundamental firm value. We denote the deviation EXMR for EXcess Market Reaction to earnings announcements.

An obvious drawback of EXMR is that it measures only mispricing resulting from the earnings announcement itself and does not reflect possible mispricing before the earnings announcement. Nevertheless, the inability to measure mispricing before earnings announcements should lower our chances of finding a significant relationship between insider trading and stock mispricing. If we still find significant relationship between insider trading and mispricing, it must be rather strong.

Linked to the second drawback, Berkman et al. (2009) suggest that new information associated with earnings announcements tends to decrease rather than increase pricing errors. The new information in earnings announcements, which lowers mispricing, should be captured in unexpected earnings and, therefore, price adjustments towards the fundamental value associated with earnings announcements should be incorporated in fitted values of the model and not affect our EXMR measure. Nevertheless, any price adjustment of this type at the earnings announcement, by definition, would be in the opposite direction to the mispricing before the earnings announcement and so even if market over-reacts in the direction of the price adjustment, the pricing error picked up by our EXMR measure would go opposite to the original mispricing. This effect would again weaken rather than strengthen our chances of finding significant results.

The third drawback of the EXMR measure is associated with the fact that models of earnings announcement abnormal returns, such as Hong et al. (2012) document low R^2, which then means that the error terms are highly correlated

with the dependent variable. Indeed, the R^2 of our estimated model is 2% and the correlation between AR and EXMR is 95%. To reconcile the issue that AR and EXMR indeed measure something else, we compare how well do the 2 measures predict future returns. To support EXMR as a distinctive measure of mispricing, we should find that EXMR is associated with future abnormal returns versus AR is not. Table 1.6 shows that EXMR is indeed a reasonable measure of mispricing following earnings announcements. Panel A reports mean monthly excess returns of portfolios by EXMR quintiles that are held for 1, 3, 6 and 12 months.[15] We see that, across all horizons, the mean monthly excess returns are significantly higher when EXMR is the lowest (quintile 0 corresponding to underpricing) relatively to when EXMR is very high (quintile 4 corresponding to overpricing). Panel B reports Jensen's alphas when regressing the monthly excess returns on 4 factors following Carhart (1997). The alphas are significantly positive for quintile 0 that represents underpricing and significantly negative for quintile 4 that represents overpricing suggesting that underpricing leads to future positive returns and overpricing to future negative returns. A trading strategy that goes long in stocks in the lowest EXMR quintile (underpriced stocks) and short in the highest EXMR quintile (overpriced stocks) earns also large and significantly positive alpha. Results in both panels are consistent with EXMR reflecting mispricing associated with earning announcements. In contrast, Panel C shows that a trading strategy based on earnings announcement abnormal returns – going short in the highest

[15]For each quarter, we take EXMR based on earnings announcement EA_0 and then put stocks into one of 5 portfolios, based on EXMR quintile, in the month of earnings announcement EA_1 and keep it in the portfolio for 1, 3, 6 or 12 months. Means are equally weighted. We form portfolios only at the end of the current earnings quarter (in the month of earnings announcement EA_1) because in the next subsection we want to allow for insider trading during the quarter and gain comparable numbers.

quintile and long in the lowest quintile of earnings announcement abnormal returns – is not profitable. Jensen's alphas for all horizons are very small and insignificant.[16] Comparing Panels B and C reinforces our mispricing measure.

Insert Table 1.6 about here.

1.3.1 Probability of insider trading

In this section we explore in a regression setting the question of whether insiders adjust their trading strategies in response to mispricing associated with earnings announcements and how important is the mispricing relatively to the book to market ratio and long-term past returns that have been identified as important insider trading triggers in the literature (Jenter, 2005; Piotroski and Roulstone, 2005). Again, we partition all quarters into 4 types depending on insider trading direction in the quarter: (i) no insider trading, (ii) only insider sales, (iii) only insider purchases and (iv) mix of both insider purchases and sales. As we want to determine factors that predict insider trading activity in the current quarter measured as 4 possible outcomes, a multinomial logistic regression fits our set-up the best.

Table 1.7 presents the results. We treat no insider trading quarters as the reference category and therefore report 3 sets of regression coefficients: for sale, purchase and mix quarters. They should be interpreted relatively to quarters with no insider trading. Concerning explanatory variables, we are primarily interested in the effect of EXMR (the excess EA_0 market reaction) together with 12-month past return and book to market ratio. We also control for

[16]Note that we form trading portfolios only at the end of the current earning quarter (in the month of EA_1) rather than immediately after EA_1. Therefore, our Jensen's alphas are not consistent with earnings momentum patterns documented in the literature.

the fitted values of market reaction to the earnings announcement. Moreover, we control for the firm size and EPS and UE corresponding to EA_0.[17] We also include future cumulative EPS and UE over EA_1 up to EA_4 to control for insiders' foreknowledge of future cash flows. In all specifications, we also include year dummies, but we do not report them to save space. We compute robust standard errors and allow them to cluster within firms. In order to determine importance of the individual explanatory variables for predicting insider trading, we standardize the explanatory variables by subtracting their mean and scaling by their standard deviation.

Panel A of Table 1.7 shows a base model without including the EXMR mispricing measure for comparison. The estimation results confirm that insider sales and purchases are contrarian. The 12-month past return increases the odds of insider sales and decreases the odds of insider purchases, while the book to market ratio has, as expected, an opposite sign (though the coefficient for purchases is not significant).[18] Further, insiders sell more often in large firms and buy in small firms. Also in line with the contrarian trading conjecture, earnings per share at EA_0 increase the odds of insider sales and decrease the odds of insider purchases. Unexpected earnings have the same effect for insider sales, but are insignificant for insider purchases.[19] Finally, the last two explanatory variables measure the cumulative EPS and UE over the four future earnings announcements (over EA_1 to EA_4) and control for

[17] As EPS and UE are also regressors when modeling AR, we check also specifications without EPS and UE. They do not result in changed coefficients for the fitted market reaction.

[18] Comparing marginal effects of the two variables (not reported) shows that the 12-month past AR has a larger effect on the odds of insider sales and purchases relatively to the book to market ratio.

[19] Note that dropping EPS from the regression results in significant UE coefficients with the expected signs (not reported). Keeping them both in the model shows that EPS relatively to UE has more explanatory power for predicting insider trading.

insider's foreknowledge of future earnings. Interestingly, the coefficient for the future EPS is significantly positive for insider sales and significantly negative for insider purchases, which contradicts insiders' trading on foreknowledge of earnings. To profit on foreknowledge, insiders should sell before negative news and buy before positive news. This result suggests that insiders do not trade pro-actively taking advantage of future earnings news, at least within 4 future quarters. Future cumulative UE predicts only the odds of insider purchases and the coefficient is in line with foreknowledge.[20] However, the future UE becomes positive for sales and insignificant for purchases if we drop the future EPS from the model (not reported). The last column shows that mix quarters are common for larger firms and resemble pure sale quarters but all the coefficients are weaker.

Insert Table 1.7 about here.

In Panel B, we include all the regressors from Panel A and add EXMR and the fitted value, the 2 components of the EA_0 market reaction. Panel B shows that EXMR, indeed, significantly affects the odds of insider trading. The coefficient for EXMR is significant with the expected sign and relatively large in magnitude. Positive deviations from the predicted market reaction to EA_0 increase the odds of insider sales, while negative deviations increase the odds of insider purchases, which is consistent with insiders selling in response to overpricing and buying in response to underpricing. The fitted market reaction is significantly positive for insider sales and negative but insignificant

[20]We also include future cumulative return on assets (ROA) and earnings announcements abnormal returns as independent variables and the evidence remains the same. Namely, the coefficient for the future ROA is significantly positive for insider sales and negative but insignificant for insider purchases, contradicting again trading on foreknowledge. Moreover, the coefficients for future earnings announcements abnormal returns are not significant for insider sales, and only weakly significant and positive for insider purchases.

for purchases suggesting that insider trading also responds to simple contrarian triggers contained in the market reaction to earnings announcements. This effect is more important for sales rather than purchases, which is consistent with insiders satisfying their liquidity or diversification needs for some of their selling transactions. Even when selling for diversification or liquidity needs, insiders prefer doing so when prices are high rather than low.

The coefficients for past returns and book to market ratio drop only slightly after including the 2 components of earnings announcement market reaction, especially for sales. Past returns still significantly predict the odds of insider purchases and sales, which suggests that earnings versus past returns both reflect mispricing and with little overlap. Insider trading is sensitive to both. We are not able to measure deviations from fundamental firm value that correspond to past return as we do for earnings announcement market reaction due to lack of appropriate models and complicated set-up without precise timings. However, it is quite likely that the mispricing component for past returns would also be an important predictor of insider purchanses and sales.

The interpretation of the economic impact of multinomial logit coefficients is not straightforward as marginal effects are not constant but change as values of all explanatory variables change. To better understand and compare the economic effects of the two components of the market reaction and of past abnormal returns and book to market ratio, we compute fitted values of probabilities fixing all explanatory variables to their mean values and at the same time letting one of the 4 explanatory variables at a time move 1 standard deviation around its mean. This allows us to determine the effect of 2 standard deviation change of the given variable on the probability of insider sales and purchases. The corresponding change in probability of sales is 11%, 8%, 12%

and –6% as a result of change of 2 standard deviations around the mean of EXMR, fitted market reaction, past AR and book to market ratio, respectively. For the probability of purchases, the corresponding changes are –5%, –1%, –5% and 1%. These changes in probabilities show that the economic effect of EXMR is comparable to the effect of the fitted market reaction and past returns. The effect of the market to book ratio is considerably smaller. The economic effects suggest that the impact of mipricing after earnings announcements on insider trading is economically meaningful.

Panel C decomposes the overall effect of EXMR conditional on good, no or bad news. In line with section 1.2, we see that insider sales and purchases are more likely both after good and bad earnings news. Even though the effect of EXMR is stronger for good news for sales and bad news for purchases, EXMR is still significant and large in magnitude also for insider sales with bad news and insider purchases with good news.[21] Thus, mispricing does not induce insider trading only in situations that are consistent with contrarian trading. For sales, EXMR is significant also with no news, but the coefficient is significantly smaller relatively to the other 2 interaction terms. The economic effects do not change much relatively to Panel B.

1.3.2 Calendar time portfolio returns with insider trading on mispricing

As a last step of our analysis, Table 1.8 shows Jensen's alphas for trading strategies conditional on insider trading and mispricing. We use the four-factor model with horizons over 1, 3, 6 and 12 months. Each quarter, we put

[21] All the interaction terms are significantly different from each other for both insider sales and purchases.

stocks into 5x3 portfolios according to EXMR quitiles based on earnings announcement EA_0 and insider trading (3 partitions based on insider purchases, sales or no insider trading as defined above in section 1.3.1). Stocks are put in the corresponding portfolio at the beginning of the month with the earnings announcement EA_1. Each monthly excess return of a portfolio is weighted by the square root of the number of stocks in the portfolio in the month to reflect clustering of insider trading in certain periods (Kothari and Warner, 2007).

According to our hypothesis, trading strategies that follow insider purchases when stock is underpriced and insider sales when stock is overpriced should lead to abnormal future profits. Accordingly, we consider 3 trading strategies that compare (i) quarters with insider sales when the firm is in the top EXMR quintile, (ii) quarters with insider purchases when the firm is in the bottom EXMR quintile and (iii) quarters without any insider trading. Table 1.8 shows that all 3 trading strategies are significantly profitable across all horizons and Jensen's alphas are economically large (for example ranging from 50 to 110 basis points per month with the 3 month investment horizon). Moreover, the third trading strategy that goes long in undervalued stocks with insider purchases and short in overvalued stocks with insider sales overperforms the trading strategy in Table 1.6 that is conditioned only on mispricing and disregards insider trading. This suggests that insiders are better able to pick stock relatively to EXMR, our mispricing measure. Their perception of fundamental firm value is better relatively to our proxy.[22] Overall, section 1.3 suggests that insider trading patters reflect mispricing after earnings announcements and

[22]We also analyze post insider trading buy and hold abnormal returns (as opposed to Jensen's alpha) over 1, 3, 6 and 12 months conditional on insider trading and mispricing and confirm that insider purchases and sales in mispriced quarters are associated with abnormal future returns. The buy and hold abnormal returns are computed the same way as in section 1.2.

that insider trading that takes into account this aspect is profitable.

1.4 Conclusions

The literature has shown that insiders trade in a contrarian fashion (Piotroski and Roulstone, 2005; Jenter, 2005). Our paper provides new evidence suggesting that insider selling (buying) patterns are associated with positive (negative) deviations of stock prices from their fundamental firm value rather than plainly with high (low) stock prices. We focus on mispricing associated with earnings announcements because mispricing gets more pronounced around news releases (Engelberg et al., 2015). Also, based on existing models for earnings announcements we are actually able to measure the expected market reaction and the corresponding over- or under-reaction to the announcement.

Thus, we model the 'normal' market reaction to an earning announcement and then compute the deviation of the realized abnormal return from the model's fitted value. If the model's fitted value represents the fair effect of the earning news, the deviation from this fair value should reflect mispricing. Consistent with our hypothesis, insiders are more likely to sell after larger positive deviations and buy after larger negative deviations of this measure. The explanatory power of the mispricing measure in predicting insider trading is high compared to the past 1-year abnormal return and book to market ratio, the two measures that have been suggested in the literature as the main determinants of insider trading (Jenter, 2005; Piotroski and Roulstone, 2005), but also relatively to the fitted market reaction. Importantly, we also show that the Jensen's alpha of trading strategies based on insider trading and mispricing is significant and economically meaningful. Insider trading on

mispricing after earnings announcements predicts future returns.

In addition, we also provide new evidence concerning the horse race between insiders trading passively on private interpretation of publicly disclosed information versus trading actively on future earnings innovations. In contrast to Piotroski and Roulstone (2005), our results show that the odds of neither insider purchases nor sales are associated with 1-year ahead earnings innovations in a way that would suggest insider trading on their foreknowledge of future changes in earnings.

Altogether, our analysis suggests that insiders trade on public information. They are attentive to their firms' stock price deviations from the fundamental firm value. They trade after public announcements of earnings when their informational advantage is minimal and, therefore, the risk of prosecution following their trading is small. As insider trading is in line with future price reversals back to fundamental values, it might help to signal and detect the mispricing and, therefore, enhance stock market efficiency. In a broad perspective, our results are consistent with the view that U.S. insider trading regulation is effective in minimizing insider trading on foreknowledge that is harmful to information collection and price discovery of outside investors (Fishman and Hagerty, 1992; Leland, 1992). However, insiders are still able to profit from their deep and intimate knowledge of their firms but in ways that seem to enhance rather than harm stock price efficiency.

1.5 Appendix

Variable definitions

Variable	Definition	Source
Any (insider) trades	Dummy variable that is equal to 1 in a quarter with any insider trading transaction and 0 otherwise.	Thomson Financial
Bad news	Dummy variable that is equal to 1 for all firm-quarters in the lowest tercile by EA_0 3-day abnormal return and 0 otherwise.	COMPUSTAT, CRPS
Book to market ratio	Book value of equity corresponding to the previous quarter over the market cap 2 days before the earnings announcement	COMPUSTAT
Book to market ratio quintile	A number between 0 and 5 depending on the book to market ratio with 0 referring to growth firms and 5 to value firms. The cut-off points are as defined on Kenneth French's web site.	COMPUSTAT, French's web site
CumEPS	Sum of EPS over EA_1 to EA_4.	COMPUSTAT
CumUE	Sum of UE over EA_1 to EA_4.	COMPUSTAT, IBES
EA_0 or EA_1 AR	Raw stock return over 3 days around EA_0 or EA_1 adjusted for the corresponding 5x5 size and book to market portfolio return as downloaded from the Kenneth French web site or the market portfolio return.	CRSP, French's web site
EPS (EA_0 or EA_1)	Net earnings before extraordinary items per share less the earnings per share four quarters back all scaled by the closing stock price 2 days before the announcement date. Corresponds to EA_0 or EA_1.	COMPUSTAT
EXMR (excess market reaction)	The difference between the realized EA_0 and the estimated 'normal' abnormal return for EA_0. The estimation model is described in section 1.3.	COMPUSTAT, IBES, CRPS
Fitted market reaction	The estimated 'normal' abnormal return for EA_0. The model for earnings announcement abnormal returns is described in section 1.3.	COMPUSTAT, IBES, CRPS
Good news	Dummy variable that is equal to 1 for all firm-quarters in the highest tercile by EA_0 3-day abnormal return and 0 otherwise.	COMPUSTAT, CRPS
Intensive trading	Dummy variable that is equal to 1 for all firm-quarters in the highest tercile by the number of shares traded by all insiders and 0 otherwise.	COMPUSTAT, Thomson Financial
Market capitalization (MCAP)	Stock price times the number of shares outstanding 2 days before the earnings announcement date.	COMPUSTAT
Market capitalization quintile	A number between 0 and 5 depending on the market cap with 0 referring to the smallest size. The cut-off points are as defined on Kenneth French's web site.	COMPUSTAT, French's web site

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Variable	Definition	Source
Mix of purchases & sales (Mix quarter)	Dummy variable that is equal to 1 for a quarter with both insider purchases and sales and 0 otherwise.	Thomson Financial
No (insider) trades (No IT quarter)	Dummy variable that is equal to 1 in a quarter without any insider trading transactions and 0 otherwise.	Thomson Financial
No news	Dummy variable that is equal to 1 for all firm-quarters in the middle tercile by EA_0 3-day abnormal return and 0 otherwise.	COMPUSTAT, CRPS
Number of analysts (NUMAN)	The number of forecasts by different analysts concerning the earnings announcement.	IBES
Number of transactions	The total number of insider-purchase or insider-sale days in a quarter. We cumulate all trades in the same direction by an insider on the same day. This means that insider purchase (sale) transaction refers to a insider-day-purchase (sale).	Thomson Financial
Only purchases	Dummy variable that is equal to 1 in a quarter with insider trading when all insider transactions in the quarter are purchases and 0 otherwise.	Thomson Financial
Only sales	Dummy variable that is equal to 1 in a quarter with insider trading when all insider transactions in the quarter are sales and 0 otherwise.	Thomson Financial
Other insiders' sales (purchases)	Quarters with sales (purchases) only by insiders who are not CEOs or CFOs of the company.	Thomson Financial
PastAR (PostAR)	The raw stock return ending (beginning) 1 days after (before) EA_0 (EA_1) adjusted for the corresponding 5x5 size and book to market portfolio return as downloaded from the Kenneth French web site or the market portfolio return. Abnormal returns are computed over the horizons of 1, 3, 6 and 12 months, which corresponds to 22, 64, 128 and 265 working days.	CRSP, French's web site
Purchase quarter	Dummy variable that is equal to 1 in a quarter with insider trading when all insider transactions in the quarter are purchases and 0 otherwise.	Thomson Financial
Quarter	Period between 2 earnings announcements.	COMPUSTAT
ROA	Net earnings before extraordinary items over total assets.	COMPUSTAT
Sale quarter	Dummy variable that is equal to 1 in a quarter with insider trading when all insider transactions in the quarter are sales and 0 otherwise.	Thomson Financial
Size	The natural logarithm of market capitalization.	COMPUSTAT
Shares traded	Total number of shares purchased or sold by all insiders as a fraction of all shares outstanding in a quarter.	Thomson Financial
Top executives' sales (purchases)	Quarters when CEOs or CFOs sell (buy) shares.	Thomson Financial

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Variable	Definition	Source
UE (EA_0 or EA_1)	Unexpected earnings is the net earnings before extraordinary items per share minus the mean analyst forecast all scaled by the closing stock price 2 days before the announcement date. Corresponds to EA_0 or EA_1.	COMPUSTAT, IBES
VOL	Variance of stock returns over one month ending on day –24 relative to EA_0.	CRSP

Table 1.1: Basic insider trading statistics

The table displays summary statistics for insider trading on the firm-quarter level. A quarter is defined as the time between 2 earnings announcements. Each quarter is classified as one of the following: containing (i) only insider purchases, (ii) only insider sales, (iii) both insider purchases and insider sales or (iv) no insider trading transactions. A quarter is classified as *Any trade* if it contains at least 1 transaction regardless of its direction. In Panel A, *All quarters* shows frequencies for the pool of all firm-quarters. *Number of transactions* stands for the average of the number of all transactions (insider-days) in a quarter. *Shares traded* shows the average total number of shares traded by all insiders in a quarter as a fraction of all shares outstanding. Panel B shows the frequencies from the first line in Panel A, but partitioned according to insider trading activity in the previous quarter.

	Any trades	No trades	Only purchases	Only sales	Mix purch.&sales
Panel A:					
All quarters	42.4%	57.6%	10.0%	26.9%	5.5%
Number of transactions	5.22		3.16	5.60	7.09
Shares traded	0.43%		0.27%	0.44%	0.62%
Panel B:					
No insider trading last quarter	25.1%	74.9%	8.4%	14.0%	2.8%
Only purchases last quarter	51.0%	49.0%	31.5%	12.0%	7.5%
Only sales last quarter	69.7%	30.3%	4.5%	57.6%	7.6%
Mix last quarter	73.1%	26.9%	13.8%	39.0%	20.3%

Table 1.2: Basic statistics

The table displays earnings announcement summary statistics for all firm-quarters in our data set. Panel A summarizes the earnings variables and valuations at the beginning of the quarter and shows the number of observations, mean and standard deviation of the mean. Panel B reports abnormal returns before (PastAR) and after (PostAR) the current quarter for all, sale, purchase and mix quarters, respectively. Abnormal returns are computed as buy and hold returns and are adjusted for 5x5 size and book to market portfolio returns. We indicate significance at the one-, five- and ten-percent level as ^{a}, ^{b} and ^{c}, respectively. All variables are defined in Appendix 1.5 and are winsorized at the 1^{st} and 99^{th} percentiles.

Panel A:	# observations	Mean	S.e(mean)	
ROA	127,619	-5.8%	0.08%	
EPS	104,470	-2.2%	0.04%	
Number of analysts	80,766	6.97	0.02	
UE	77,807	-0.5%	0.02%	
Market capitalization	103,849	2,426	22	
Market cap quintile	103,602	0.93	0.004	
Book to market ratio	99,020	0.63	0.002	
Book to market quintile	99,020	1.65	0.005	
Panel B:	All quarters	Sale quarters	Purchase quarters	Mix quarters
# firm-quarters	101,725	32,074	10,458	6,450
1-year PastAR	2.25%^{a}	16.38%^{a}	-14.40%^{a}	7.79%^{a}
6-month PastAR	0.64%^{a}	9.57%^{a}	-11.01%^{a}	3.35%^{a}
3-month PastAR	0.26%^{a}	5.97%^{a}	-7.67%^{a}	0.55%^{c}
1-month PastAR	-0.24%^{a}	3.03%^{a}	-5.58%^{a}	-0.53%
EA_0 AR	0.02%	1.48%^{a}	-2.18%^{a}	-0.14%
EA_1 AR	-0.01%	0.04%	0.21%^{b}	0.25%^{b}
1-month PostAR	-0.16%^{a}	-0.34%^{a}	0.65%^{a}	0.44%^{b}
3-month PostAR	0.55%^{a}	-0.18%	2.06%^{a}	1.29%^{a}
6-month PostAR	1.25%^{a}	-0.19%	4.03%^{a}	1.88%^{a}
1-year PostAR	2.31%^{a}	-0.51%^{b}	7.37%^{a}	3.01%^{a}

Table 1.3: Post insider trading performance by earnings surprise

The table displays on quarterly basis the average future 3-day, 1, 3, 6 and 12-month buy and hold abnormal returns starting 1 day before EA_1. It also shows the average cumulative EPS and UE over EA_1 up to EA_4 and the number of quarters (observations) covered. All the averages are conditional on the 3-day EA_0 abnormal return belonging to the highest tercile for good news, middle tercile for no news and the lowest tercile for bad news. All abnormal returns are computed as the buy-and-hold abnormal returns and are adjusted for a corresponding 5x5 size and book to market portfolio return in Panel A and for a equally weighted market index return in Panel B. We indicate significance at the one-, five- and ten-percent level as ^{a}, ^{b} and ^{c}, respectively. All variables are defined in Appendix 1.5 and are winsorized at the 1^{st} and 99^{th} percentiles.

	3-day AR EA_1	1-month PostAR	3-month PostAR	6-month PostAR	12-month PostAR	Cum EPS $EA_1 - EA_4$	Cum UE $EA_1 - EA_4$	# quarters
Panel A: Size and B/M adjusted								
Good news								
sale quarters	-0.14%^{c}	-0.89%^{a}	-0.56%^{a}	-0.50%^{c}	-1.11%^{a}	0.009^a	-0.004^a	12586
no IT quarters	0.11%	-0.09%	1.38%^{a}	3.14%^{a}	4.69%^{a}	-0.070	-0.013^a	16312
purchase quarters	0.54%^{a}	1.11%^{a}	3.66%^{a}	6.84%^{a}	9.65%^{a}	-0.132^a	-0.028^a	2776
No news								
sale quarters	0.23%^{a}	0.03%	0.13%	0.20%	0.61%	0.011^a	-0.004^a	11033
no IT quarters	-0.02%	-0.22%^{c}	0.22%	0.79%^{a}	2.15%^{a}	-0.059	-0.013^a	17439
purchase quarters	0.29%^{c}	0.69%^{b}	1.19%^{b}	2.41%^{a}	6.84%^{a}	-0.118^a	-0.027^a	3115
Bad news								
sale quarters	0.10%	0.06%	0.09%	-0.15%	-1.08%^{b}	-0.035^a	-0.009^a	8394
no IT quarters	-0.41%^{a}	-0.48%^{a}	0.28%	0.86%^{b}	2.06%^{a}	-0.151	-0.025^a	18718
purchase quarters	-0.09%	0.30%	1.67%^{a}	3.56%^{a}	6.28%^{a}	-0.194^a	-0.031^a	4503
Panel B: Market adjusted								
Good news								
sale quarters	-0.18%^{b}	-1.02%^{a}	-1.38%^{a}	-2.04%^{a}	-3.42%^{a}			
no IT quarters	0.08%	-0.05%	1.31%^{a}	3.04%^{a}	4.21%^{a}			
purchase quarters	0.49%^{b}	1.37%^{a}	4.17%^{a}	7.19%^{a}	10.25%^{a}			
No news								
sale quarters	0.22%^{a}	0.01%	-0.58%^{a}	-1.03%^{a}	-1.19%^{a}			
no IT quarters	-0.05%	-0.23%^{c}	0.08%	0.61%^{b}	1.58%^{a}			
purchase quarters	0.28%^{c}	0.73%^{b}	1.18%^{b}	2.16%^{a}	6.29%^{a}			
Bad news								
sale quarters	0.05%	-0.07%	-0.71%^{b}	-1.61%^{a}	-3.36%^{a}			
no IT quarters	-0.46%^{a}	-0.46%^{a}	0.26%	0.91%^{a}	1.72%^{a}			
purchase quarters	-0.15%	0.50%	1.91%^{a}	3.92%^{a}	6.61%^{a}			

Table 1.4: Post insider trading performance: top executives versus other insiders

The table displays on quarterly basis the average future 3-day, 1, 3, 6 and 12-month buy and hold abnormal returns starting 1 day before EA_1 conditional on quarters with insider sales or insider purchases and further partitions them depending on CEO/CFO trading in the quarter (Top executives) or no CEO/CFO trading (Other insiders). Both groups are further conditioned on top and bottom terciles of EA_0 announcement abnormal return (good news/bad news) and top tercile of total number of shares sold by all insiders in the quarter as a fraction of all shares outstanding (intensive trading). All abnormal returns are computed as the buy-and-hold abnormal returns and are adjusted for a corresponding 5x5 size and book to market portfolio return in Panel A and for a equally weighted market index return in Panel B. We indicate significance at the one-, five- and ten-percent level as ^{a}, ^{b} and ^{c}, respectively. All variables are defined in Appendix 1.5 and are winsorized at the 1^{st} and 99^{th} percentiles.

	3-day AR EA_1	1-month PostAR	3-month PostAR	6-month PostAR	12-month PostAR	# quarters
Panel A: Size and B/M adjusted						
Top executives' sales	-0.02%	-0.56%^{a}	-0.48%^{b}	-0.60%^{b}	-1.23%^{a}	13404
good news	-0.29%^{b}	-1.24%^{a}	-1.00%^{a}	-0.90%^{b}	-1.98%^{a}	5695
bad news	0.12%	-0.17%	-0.35%	-0.96%^{c}	-2.20%^{a}	3167
intensive trading	-0.21%^{c}	-1.03%^{a}	-0.82%^{a}	-1.22%^{a}	-2.22%^{a}	6326
Other insiders' sales	0.09%	-0.19%^{c}	0.02%	0.09%	0.00%	19055
good news	0.00%	-0.61%^{a}	-0.19%	-0.17%	-0.39%	6913
bad news	0.09%	0.20%	0.35%	0.35%	-0.40%	5246
intensive trading	-0.01%	-0.55%^{b}	0.04%	0.62%	1.23%	4401
Top executives' purchases	0.35%^{c}	1.31%^{a}	2.96%^{a}	5.85%^{a}	9.61%^{a}	3706
good news	0.34%	2.05%^{a}	5.66%^{a}	10.55%^{a}	14.04%^{a}	868
bad news	0.13%	0.87%	2.88%^{a}	5.50%^{a}	8.52%^{a}	1729
intensive trading	-0.02%	1.52%^{b}	5.34%^{a}	8.98%^{a}	17.61%^{a}	1311
Other insiders' purchases	0.14%	0.30%	1.59%^{a}	3.09%^{a}	6.21%^{a}	7169
good news	0.63%^{a}	0.68%	2.75%^{a}	5.17%^{a}	7.66%^{a}	1928
bad news	-0.23%	-0.06%	0.93%	2.37%^{a}	4.91%^{a}	2797
intensive trading	0.05%	0.21%	1.46%^{c}	2.30%^{b}	6.61%^{a}	2241
Panel B: Market adjusted						
Top executives' sales	-0.05%	-0.64%^{a}	-1.28%^{a}	-1.98%^{a}	-3.36%^{a}	13447
good news	-0.33%^{a}	-1.37%^{a}	-1.82%^{a}	-2.30%^{a}	-4.12%^{a}	5695
bad news	0.08%	-0.30%	-1.23%^{a}	-2.57%^{a}	-4.74%^{a}	3167
intensive trading	-0.24%^{c}	-1.19%^{a}	-1.71%^{a}	-2.74%^{a}	-4.77%^{a}	6339
Other insiders' sales	0.05%	-0.28%^{a}	-0.72%^{a}	-1.33%^{a}	-2.09%^{a}	19129
good news	-0.06%	-0.73%^{a}	-1.00%^{a}	-1.82%^{a}	-2.84%^{a}	6913
bad news	0.03%	0.07%	-0.39%	-1.04%^{b}	-2.52%^{a}	5246
intensive trading	-0.06%	-0.71%^{a}	-0.65%	-0.71%	-1.15%	4415
Top executives' purchases	0.30%^{c}	1.65%^{a}	3.73%^{a}	6.96%^{a}	11.00%^{a}	3721
good news	0.32%	2.66%^{a}	6.79%^{a}	12.06%^{a}	16.34%^{a}	868
bad news	0.06%	1.27%^{b}	3.58%^{a}	6.65%^{a}	9.86%^{a}	1729
intensive trading	-0.04%	2.14%^{a}	7.04%^{a}	12.11%^{a}	21.65%^{a}	1318
Other insiders' purchases	0.09%	0.37%	1.56%^{a}	2.81%^{a}	5.77%^{a}	7215
good news	0.57%^{b}	0.78%^{c}	2.99%^{a}	5.00%^{a}	7.48%^{a}	1928
bad news	-0.28%	0.03%	0.89%	2.24%^{b}	4.61%^{a}	2797
intensive trading	0.01%	0.48%	1.82%^{b}	2.84%^{b}	6.95%^{a}	2257

Table 1.5: Post insider trading performance: regression analysis

The table displays regression results for the 1, 3, 6 and 12-month post insider trading abnormal returns. A quarter is marked as with insider purchases (sales) in case all insider trades in the current quarter are purchases (sales) and as following a good, no or bad earnings news if it belongs to the top (bottom) tercile by the 1-month abnormal return ending 1 day after EA_0. All abnormal returns are computed as the buy-and-hold abnormal returns adjusted for a corresponding 5x5 size and book to market portfolio return. We report Hubert/White robust standard errors that are also clustered within firms. All variables are defined in Appendix 1.5 and are winsorized at the 1^{st} and 99^{th} percentiles. Year dummies are included in the regressions but are not reported. We indicate significance at the one-, five- and ten-percent level as ^{a}, ^{b} and ^{c}, respectively.

	1-month		3-month		6-month		12-month	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Panel A								
Sales x good news	-0.012^a	0.002	-0.014^a	0.003	-0.021^a	0.004	-0.023^a	0.006
Sales x no news	-0.007^a	0.001	-0.007^a	0.002	-0.005	0.004	-0.009	0.006
Sales x bad news	-0.001	0.002	-0.013^a	0.003	-0.018^a	0.005	-0.025^a	0.008
Purchases x good news	0.015^a	0.004	0.019^b	0.007	0.040^a	0.010	0.049^a	0.017
Purchases x no news	0.004	0.003	-0.004	0.005	-0.004	0.008	0.017	0.013
Purchases x bad news	0.017^a	0.003	0.029^a	0.005	0.043^a	0.008	0.077^a	0.012
CumEPS(EA_1-EA_4)	0.024^a	0.001	0.044^a	0.002	0.063^a	0.003	0.062^a	0.005
Size	-0.003^a	0.001	-0.017^a	0.001	-0.032^a	0.002	-0.045^a	0.004
# observations	88,336		87,293		86,556		83,598	
R^2	0.019		0.026		0.027		0.018	
F-test	49.19		57.98		55.42		28.86	
Panel B								
Sales x good news	-0.008^a	0.002	-0.009^a	0.003	-0.012^a	0.004	-0.008	0.006
Sales x no news	-0.006^a	0.002	-0.007^a	0.002	-0.004	0.004	-0.006	0.006
Sales x bad news	-0.001	0.002	-0.011^a	0.003	-0.014^a	0.005	-0.017^b	0.008
Purchases x good news	0.012^b	0.005	0.012	0.008	0.034^a	0.011	0.042^b	0.018
Purchases x no news	0.003	0.003	-0.008	0.006	-0.008	0.008	0.010	0.013
Purchases x bad news	0.016^a	0.003	0.027^a	0.006	0.039^a	0.008	0.068^a	0.013
CumEPS(EA_1-EA_4)	0.028^a	0.001	0.053^a	0.002	0.074^a	0.003	0.079^a	0.006
Size	-0.001^b	0.001	-0.013^a	0.001	-0.023^a	0.002	-0.031^a	0.004
Book to market ratio	0.008^a	0.001	0.013^a	0.001	0.022^a	0.002	0.033^a	0.005
12-month PastAR	-0.008^a	0.001	-0.014^a	0.001	-0.020^a	0.002	-0.024^a	0.003
# observations	77,089		76,710		76,090		73,619	
R^2	0.025		0.035		0.036		0.024	
F-test	60.35		75.87		62.06		29.19	
Panel C								
Top sales x good news	-0.010^a	0.002	-0.009^b	0.004	-0.008	0.005	-0.005	0.009
Other sales x good news	-0.008^a	0.002	-0.009^a	0.003	-0.015^a	0.005	-0.010	0.007
Sales x no news	-0.007^a	0.002	-0.007^a	0.002	-0.004	0.004	-0.006	0.006
Other sales x bad news	-0.002	0.002	-0.011^a	0.004	-0.011^c	0.006	-0.014	0.009
Top sales x bad news	-0.000	0.003	-0.011^b	0.005	-0.019^b	0.008	-0.021^c	0.012
Top purch. x good news	0.021^b	0.010	0.024	0.016	0.071^a	0.023	0.073^b	0.036
Other purch. x good news	0.009^c	0.005	0.007	0.008	0.019	0.012	0.029	0.019
Purchases x no news	0.003	0.003	-0.008	0.006	-0.008	0.008	0.010	0.013
Other purch. x bad news	0.010^b	0.004	0.019^a	0.006	0.033^a	0.010	0.063^a	0.015
Top purch. x bad news	0.025^a	0.006	0.040^a	0.009	0.048^a	0.013	0.075^a	0.021
CumEPS(EA_1-EA_4)	0.028^a	0.001	0.053^a	0.002	0.075^a	0.003	0.079^a	0.006
Size	-0.001^b	0.001	-0.013^a	0.001	-0.023^a	0.002	-0.031^a	0.004
Book to market ratio	0.008^a	0.001	0.013^a	0.001	0.022^a	0.002	0.033^a	0.005
12-month PastAR	-0.008^a	0.001	-0.014^a	0.001	-0.020^a	0.002	-0.024^a	0.003
# observations	77,089		76,710		76,090		73,619	
R^2	0.025		0.035		0.036		0.024	
F-test	49.10		61.55		50.44		23.66	

Table 1.6: EXMR as a measure of mispricing

This table shows results for calendar-time portfolio analysis across quintiles of EXMR (excess EA_0 market reaction) in Panels A and B and quintiles of earnings announcement abnormal return, AR, (EA_0 market reaction) over 4 different horizons. Each quarter, we assign stocks into five portfolios according to EXMR (AR) quintiles and hold them in the fortfolios for 1, 3, 6 or 12 months from the month of EA_1. We calculate the portfolio return in a given month as the equally-weighted average of returns of all stocks in the portfolio. In Panel A, we report average monthly portfolio returns by quintiles of EXMR. In Panels B and C, we report the intercepts (alphas) of four-factor regression models across EXMR and AR quintiles, respectively. We include all available stocks with stock price greater than \$5 at the time of portfolio formation and non-empty observations for EXMR. Monthly returns are winsorized at the 1^{st} and 99^{th} percentiles. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

	1-month horizon	3-month horizon	6-month horizon	12-month horizon
Panel A: Mean monthly excess returns				
EXMR quintiles:				
Quintile 0 (underpricing)	1.84%	1.39%	1.18%	1.03%
Quintile 1	1.35%	1.09%	1.03%	0.94%
Quintile 2	1.11%	0.88%	0.82%	0.76%
Quintile 3	0.97%	0.85%	0.88%	0.77%
Quintile 4 (overpricing)	0.80%	0.64%	0.69%	0.55%
Difference btw. Q0 and Q4	1.04%^{a}	0.74%^{a}	0.48%^{a}	0.48%^{a}
	(0.001)	(0.001)	(0.001)	(0.000)
Panel B: Four-factor alphas				
EXMR quintiles:				
Quintile 0 (underpricing)	0.008^a	0.005^a	0.003^a	0.003^a
	(0.001)	(0.001)	(0.001)	(0.001)
Quintile 1	0.003^b	0.003^a	0.002^a	0.002^a
	(0.001)	(0.001)	(0.001)	(0.001)
Quintile 2	0.003^a	0.002^b	0.002^b	0.002^b
	(0.001)	(0.001)	(0.001)	(0.001)
Quintile 3	0.001	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Quintile 4 (overpricing)	-0.002^b	-0.002^b	-0.002^c	-0.002^b
	(0.001)	(0.001)	(0.001)	(0.001)
Long in Q0, short in Q4	0.011^a	0.007^a	0.005^a	0.005^a
	(0.002)	(0.001)	(0.001)	(0.001)
Panel C: Four-factor alphas				
AR quintiles:				
Quintile 0 (low market reaction)	0.003^c	0.000	-0.001	0.000
	(0.002)	(0.002)	(0.001)	(0.001)
Quintile 1	0.002^b	0.002^c	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Quintile 2	0.002^a	0.002^b	0.002^b	0.002^a
	(0.001)	(0.001)	(0.001)	(0.001)
Quintile 3	0.002^c	0.002^c	0.002^a	0.003^a
	(0.001)	(0.001)	(0.001)	(0.001)
Quintile 4 (high market reaction)	0.002	0.002	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Long in Q0, short in Q4	0.001	-0.002	-0.002	-0.000
	(0.002)	(0.002)	(0.001)	(0.001)

Table 1.7: Analysis of factors influencing the likelihood of insider trading.

This table reports estimation results for a multinomial logistic model. The dependent variable is a categorical variable that equals 0 for quarters without any insider trading, 1 for all quarters with insider sales only, 2 for all quarters with only insider purchases and 3 for mix quarters. No IT quarters is the reference category and so the table reports 3 sets of estimated coefficients: for sale, purchase and mix quarters. The coefficients should be interpreted relatively to the reference category of no IT quarters. We normalize the explanatory variables by subtracting the mean and dividing by the standard deviation. The book to market ratio and size are lagged one quarter. We report Hubert/White robust standard errors and allow them to cluster within firms. All variables are defined in Appendix 1.5 and are winsorized at the 1^{st} and 99^{th} percentiles. Year dummies are included in the regressions but are not reported. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

	Sale qrtr		Purchase qrtr		Mixed qrtr	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Panel A						
Constant	-1.374^{a}	0.028	-2.069^{a}	0.035	-3.087^{a}	0.056
12-month PastAR	0.301^{a}	0.014	-0.256^{a}	0.026	0.190^{a}	0.022
Book to market ratio	-0.114^{a}	0.027	-0.023	0.024	-0.061	0.041
Size	0.428^{a}	0.023	-0.177^{a}	0.033	0.464^{a}	0.039
EPS(EA_0)	0.156^{a}	0.034	-0.130^{a}	0.018	-0.028	0.042
UE(EA_0)	0.070^{a}	0.022	0.005	0.016	-0.050^{c}	0.027
CumEPS(EA_1-EA_4)	0.256^{a}	0.028	-0.049^{b}	0.022	0.077^{b}	0.038
CumUE(EA_1-EA_4)	-0.007	0.020	0.040^{b}	0.018	-0.020	0.027
# observations	60,897					
χ^2	4936					
Pseudo R^2	7.72%					
Panel B						
Constant	-1.399^{a}	0.029	-2.101^{a}	0.036	-3.091^{a}	0.057
EXMR	0.240^{a}	0.010	-0.224^{a}	0.016	0.045^{b}	0.018
Fitted market reaction	0.209^{a}	0.020	-0.008	0.023	0.081^{b}	0.032
12-month PastAR	0.279^{a}	0.014	-0.201^{a}	0.024	0.180^{a}	0.022
Book to market ratio	-0.151^{a}	0.027	-0.011	0.025	-0.075^{c}	0.042
Size	0.428^{a}	0.023	-0.182^{a}	0.034	0.459^{a}	0.040
EPS(EA_0)	0.108^{a}	0.033	-0.143^{a}	0.020	-0.025	0.048
UE(EA_0)	-0.022	0.023	0.004	0.019	-0.078^{b}	0.033
CumEPS(EA_1-EA_4)	0.222^{a}	0.028	-0.047^{b}	0.023	0.067^{c}	0.040
CumUE(EA_1-EA_4)	-0.006	0.023	0.041^{b}	0.019	-0.021	0.029
# observations	60,269					
χ^2	5543					
Pseudo R^2	8.47%					

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	Sale qrtr		Purchase qrtr		Mixed qrtr	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Panel C						
Constant	-1.422^a	0.029	-2.127^a	0.037	-3.145^a	0.059
EXMR x good news	0.309^a	0.017	-0.208^a	0.028	0.171^a	0.030
EXMR x no news	0.170^a	0.024	0.016	0.037	0.022	0.043
EXMR x bad news	0.203^a	0.018	-0.307^a	0.024	-0.056^c	0.029
Fitted market reaction	0.204^a	0.020	0.002	0.023	0.077^b	0.032
12-month PastAR	0.275^a	0.014	-0.195^a	0.024	0.176^a	0.022
Book to market ratio	-0.153^a	0.027	-0.008	0.025	-0.073^c	0.042
Size	0.432^a	0.023	-0.178^a	0.034	0.468^a	0.040
EPS(EA_0)	0.108^a	0.033	-0.143^a	0.020	-0.024	0.047
UE(EA_0)	-0.023	0.023	0.001	0.019	-0.081^b	0.033
CumEPS(EA_1-EA_4)	0.221^a	0.028	-0.044^c	0.023	0.068^c	0.040
CumUE(EA_1-EA_4)	-0.006	0.023	0.041^b	0.019	-0.022	0.029
# observations	60,269					
χ^2	5608					
Pseudo R^2	8.55%					

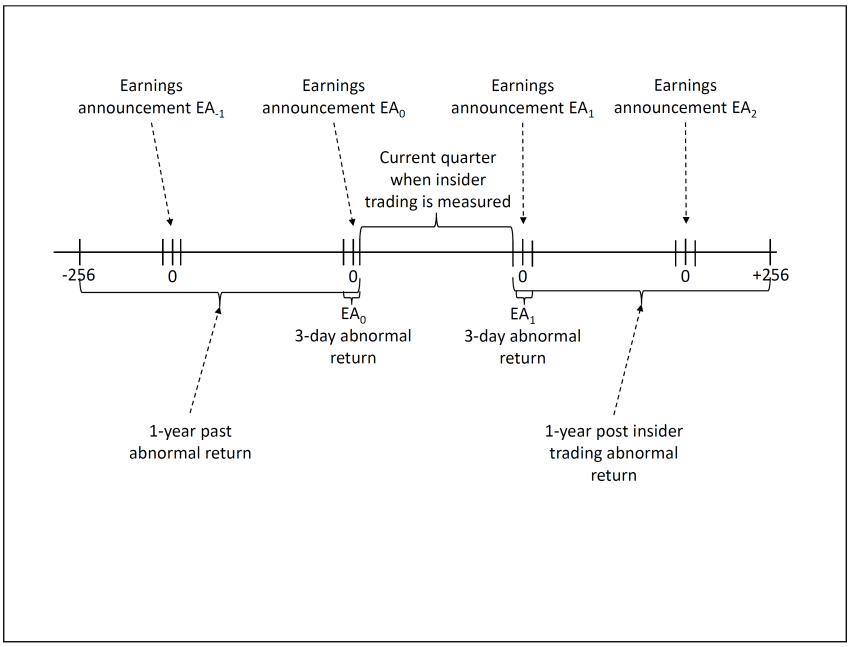
Table 1.8: Performance of insider trading on mispricing

This table reports intercepts (alphas) of four-factor regression models that regress monthly excess returns from a long-minus-short portfolio strategy on the 3 Fama and French (1993) factors and the Carhart (1997) momentum factor. The trading strategies are conditioned on EXMR quintiles and insiders trading in the quarter. Each quarter, we assign stocks into five portfolios depending on EXMR quintiles and further partition each of the portfolios based on insiders selling, buying or not trading at all in the quarter. We put stocks in the corresponding portfolio in the month of earnings announcement EA_1 and keep it there for 1, 3, 6 or 12 months. We calculate the monthly portfolio return as the weighted average return of all the stocks in the portfolio. We weight by the square root of the total number of firms included in each of the portfolios to reflect clustering of insider trading in certain periods. We include all available stocks with stock price greater than \$5 at portfolio formation. *No IT qrtr* is a portfolio including all stocks without any insider trading in the given quarter. *Sale qrtr & quintile 0 (4)* represents a portfolio of stocks in the bottom (top) EXMR quintile when insiders sell in the quarter. *Purchase qrtr & quintile 0 (4)* represents a portfolio of stocks in the bottom (top) EXMR quintile when insiders buy in the quarter. Monthly returns are winsorized at the 1^{st} and 99^{th} percentiles. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

Portfolio strategies (Long−Short)	1 month Post EA_1	3 months Post EA_1	6 months Post EA_1	12 months Post EA_1
No IT qrtr – Sale qrtr & quintile 4	0.006^{a}	0.005^{a}	0.003^{a}	0.003^{b}
	(0.002)	(0.001)	(0.001)	(0.001)
Purchase qrtr & quintile 0 – No IT qrtr	0.011^{a}	0.007^{a}	0.006^{a}	0.004^{a}
	(0.004)	(0.004)	(0.004)	(0.003)
Purchase qrtr & quintile 0 – Sale qrtr & quintile 4	0.017^{a}	0.011^{a}	0.009^{a}	0.007^{a}
	(0.004)	(0.004)	(0.003)	(0.003)

Figure 1.1: Timings of earnings announcements and related abnormal returns

The figure shows the exact timings of earnings announcements and related abnormal returns relatively to the current quarter with insider transactions. The current quarter is defined as the period between 2 earnings announcements. Earnings announcement abnormal returns are always computed over 3 days around the earnings announcement date. 1, 3, 6 and 12-month returns start (end) 2 days after (before) the earnings announcement.



Chapter 2

Insiders trading and market sentiment during earnings announcements

Corporate insiders are executives, directors or beneficial owners of more than 10% of the company stocks. Insiders are considered to be informed traders as they know their companies better than any analyst in the market and their trades show predictability of future abnormal returns.[1] However, while most of the robust evidence of returns following insider transactions is centered on stock purchases, the literature finds little evidence that insider sales are informative about future firm performance (Lakonishok and Lee, 2001; Jeng et al., 2003; Jenter, 2005). The main argument for these findings is that insiders could sell for reasons other than foreknowledge of material information, such as

[1]See for example Jaffe (1974); Seyhun (1986, 1998); Lin and Howe (1990); Rozeff and Zaman (1998); Lakonishok and Lee (2001); Jeng et al. (2003); Marin and Olivier (2008); Jagolinzer (2009); Cohen et al. (2012).

liquidity or diversification.[2] The evidence by Cohen et al. (2012) is a notable exception. They show that performing simple screening to insider trading frequencies, both insider purchases and sales are profitable and predict future returns. Cohen et al. (2012) conclude that their findings support the view that some insider sales are opportunistic and are driven by foreknowledge of future material information, and others are routine and are motivated mostly by liquidity or diversification.

If stock prices reflect all publicly available information, the evidence referred above means that a significant portion of insiders do not respect legal prohibitions about trading on non-public material information when selling. In sharp contrast, another stream of the literature argues that insiders do not use material information, but their trades reflect contrarian beliefs about market valuations[3] (Sivakumar and Waymire, 1994; Rozeff and Zaman, 1998; Piotroski and Roulstone, 2005; Jenter, 2005). This means that insiders do not use much valid inside information when trading other than the information that is already incorporated into stock prices. As a consequence, under this view insider sales are not profitable and do not predict future returns. This literature establishes that insiders time very well their transactions and trade against current investor sentiment by recognizing when their stocks are mispriced by the market.[4]

[2]See for example Lakonishok and Lee (2001), Jeng et al. (2003), Fidrmuc et al. (2006), Cheng et al. (2007) Brochet (2010) among others

[3]Under this view, insiders trade against the naive perception of investors that firms' that performed well (poor) in the past, value firms (growth), will continue to do so in the future. So a naive investor will buy value firms more, leading them to be overvalued and sell growth firms more leading them to be undervalued. The usual measures to capture this investor sentiment are past-returns and book to market ratio.

[4]Piotroski and Roulstone (2005) show that insider trades are consistent with both views, that is, trading on foreknowledge of future firm's performance and trading against current investors' sentiment, although their evidence is stronger for the second view.

In this chapter, we provide more comprehensive evidence that insiders sell against investors' sentiment by analyzing their trading strategies during public news announcements. In particular, we highlight the link between insider selling strategies, the market reaction to earnings announcements and stock mispricing through market sentiment. A positive shock in market sentiment is associated with a high demand for a stock from the most optimistic investors (Baker and Wurgler, 2006). Miller (1977) shows that stocks are more overpriced when investors' opinions about firm's value diverge more and short sales constraints are binding. This is because with high divergence in investors' opinions and binding short sale constraints, investors with pessimistic valuations do not sell the stock and prices reflect valuations of the most optimistic side of investors.[5] As a result of the overpricing, stock prices drop in the future.

We conjecture that insiders exploit high market sentiment during earnings announcements and tend to sell when market reaction to an earnings news is associated with higher divergence in investors' opinions about their firms' value. The divergence in investors' opinions comes from investors' differential interpretations of the news released in the earnings announcements (Kandel and Pearson, 1995; Brown et al., 2009; Engelberg et al., 2012). We argue that by selling in firms that experience an increase in investors' disagreement during the earnings news insiders take advantage of market sentiment, trade profitably and at the same time minimize their own legal jeopardy. Moreover, even when our analysis is centered around insider selling strategies, we also consider insider purchases as a complement. As the predictions in Miller (1977)

[5]Miller (1977) is the first establishing the link between divergence in investor's opinions and mispriced stocks, but after him there a great deal of articles testing his predictions. See for example Banerjee (2011) and Diether et al. (2002) for a comprehensive review.

model are formulated to explain overvaluation, we expect insiders buying less or not buying at all under his framework.

For a large sample of U.S. firms from January 2003 until December 2013 we show that insiders are more likely to sell stocks after earnings announcements that are associated with an increase in divergence in investors' opinions upon the news release and more binding short sale constraints. This suggests that insiders are more likely to trade when their stocks become overvalued as a result of the earnings news. Moreover, we show that when selling stocks with higher divergence in investors' opinions insider sales show strong future return predictability. This evidence is consistent with the idea that insiders may not be using much valid inside information when trading after earnings announcements. In the absence of material future information, insiders can always benefit more by selling their company's stocks and taking positions in a well-diversified portfolio (Jenter, 2005). However, if insiders disagree with the market concerning the valuation of their firms, their incentives to sell might change significantly. We argue that insiders are so eager to sell that they take each opportunity to do so. Given stringent U.S. insider trading regulation and high legal jeopardy, insiders are often trading immediately after releases of price sensitive information rather than before (Huddart et al., 2007). Use of information after it was publicly released provides higher protection against legal jeopardy.

Our main finding is that insiders are more likely to sell in firms that exhibit a large increase in divergence in investors' opinions during earnings announcements. Therefore, a key feature of the empirical design is how we measure divergence in investors' opinions. The usual measure that literature relies on is dispersion in analysts' forecasts. However, this measure doesn't capture

investors' disagreement during the short window of earnings announcements. Moreover, small firms are generally not covered by many analysts, implying important biases of the measure. Due to these important limitations of dispersion in analysts' forecasts, we propose an alternative measure: absolute order imbalance defined as the absolute value of the difference between daily buy an sell orders scaled by the total volume (Aktas et al., 2007). We validate this measure using the setup in Berkman et al. (2009), who show that stocks with higher divergence in investors' opinions (using dispersion in analysts' forecasts) and higher short sale constraints before earnings announcements earn significantly lower returns when the earnings news is released (3 days around the earnings announcement). We are able to replicate their main results with order imbalance, but we also extend their evidence by showing that an increase in divergence in investors' opinions during earnings announcements is associated with a stronger market reaction to the news.

We then explore return predictability of insider sales. We show that firms with insider sales in a given quarter show significantly lower future abnormal returns after 1 month, especially when these firms exhibit a large increase in investors' disagreement. In particular, a strategy that goes long in stocks with no insider trading and short stocks with insider sales generates positive abnormal returns after 1, 3, 6 and even 12 months of a quarter where insiders trade.

Further, we analyze whether insiders sell more intensively after earnings announcements to take advantage of market sentiment. We conjecture that if insiders better interpret the earnings news than other investors and make profits, they would be willing to trade more shares in order to pre-empt the rest from extracting the benefits. Our results confirm that insiders sell more

intensively when the divergence in investors' opinions and the market reaction to earnings news are higher.

To provide further support to our results we evaluate whether alternative measures of overvaluation show consistency with our main finding. Miller (1977) argues that overvaluation could also occur because some stocks attract more investors' attention than others and therefore prices will also reflect the valuations of the more optimistic investors who investigate about the stocks. We take trading volume and firms beating analysts' forecasts as measures for investors' attention. We show that insiders are more likely to sell when investors' attention is high during earnings announcements.

Lastly, even when our results indicate that insiders trade on the information released at the earnings announcements, it's possible that they may also be selling on foreknowledge of future material information. For instance, Lustgarten and Mande (1995) show that insiders trade on private information about future earnings announcements. Consequently, we test whether insider sales are driven by foreknowledge of future cash flows and we find no evidence that this is the case. In particular, firms with insider sales do not show a decline in future fundamental information, even when considering future information of one year ahead.

Overall, our analysis is consistent with a conclusion that some profitable insider selling is motivated by public information (Kolasinski and Li, 2010; Alldredge and Cicero, 2015). This is in line with recent evidence on attentive insider trading (Alldredge and Cicero, 2015) that argues that insiders are attentive to interpreting new public information and tend to take advantage of situations when the market is inattentive to this news. In other words, insider selling activities are motivated by their ability to better interpret and process

publicly available information. Better information processing and interpretation skills, as well as intimate and deep knowledge of their firms provides insiders with an advantage even after earnings news is released to the public domain.

Our evidence has also important policy implications as it's still unclear to which extend insider transactions are beneficial for the stock market. Arguments against insider trading state that insider transactions could crowd out information collection from outside investors and so deter the informational efficiency of the market (Fishman and Hagerty, 1992; Fernandes and Ferreira, 2009). Our results that insider sales are motivated by their skills to better analyze public information suggest that some insider trading is beneficial for the market. Our findings are in line with early studies showing that insider trading increases informational efficiency of the market (Manne, 1966; Carlton and Fischel, 1983). This is because by trading on their superior interpretation of public news, insiders help to incorporate that information more accurately into stock prices.

Alldredge and Cicero (2015) study insider trading when firms disclose concentrated business connections with other companies. They show that insiders sell profitably based on public information about their main customers. Alldredge and Cicero (2015) argue that their results are suggestive that insiders are attentive to the information released at public news announcements. We are able to extend their evidence by focusing on public news that is more frequent and determinant for insiders.[6] More importantly, our results are different as we show that insiders actively exploit situations when outside investors

[6]Our analysis show that almost 60% of insider sales occur within 1 month of the earnings announcement date.

misinterpret the news and trade, rather than occasions when outside investors are inattentive to profitable opportunities. Kolasinski and Li (2010) finds evidence that insiders buy more and sell less when their firms have underreacted to earnings news. More specifically, they show that net insider purchases follow after positive market reaction to earnings announcement when earnings surprise is low. However, our results are different as they are not conditional to the direction of the news. Therefore, we contribute to their evidence by showing that insiders are selling their stocks when are likely to be overpriced after the news release, suggesting that insiders may be selling when the market has overreacted to positive news and underreacted to negative news.

Our findings complement the evidence of Jenter (2005). He shows that insiders' contrarian trading is consistent with the intuitive idea that managers in low market valuation firms (value firms) view their stocks as undervalued and managers in high market valuation firms (growth firms) view their stocks as overvalued, suggesting that insiders are exploiting the value effect. In particular, he assumes that insider trades are motivated by mispricing and shows different results from managerial decisions that are consistent with this assumption. He also finds little evidence that managers earn significantly excess returns with their trades. We extend his evidence by showing more directly that insiders sell when their stocks are more prone of overvaluation as a result of high market sentiment during earnings announcements. We show that insiders are selling more frequently and intensively stocks that exhibit an increase in disagreement and more binding short sale constraints. More importantly, as a result of this trading strategy insider sales show strong future return predictability.

The remainder of the chapter is as follows. In Section 2.1, we introduce the

main hypotheses and related literature. In Section 2.2, we describe our data and the construction of the main variables, and we also validate our measure of divergence in investors' opinions. Section 2.3 contains our main results. Section 2.4 and 2.5 provide a robustness check and explore an alternative explanation. Section 2.6 concludes.

2.1 Related literature

A large body of literature studies the trading motives of corporate insiders. Early studies agree that insiders trade on material information not yet conveyed to the market as their transactions show predictability of future abnormal returns (Jaffe, 1974; Seyhun, 1986, 1992, 1998; Lakonishok and Lee, 2001; Jeng et al., 2003). Most of this evidence, however, focuses on the abnormal returns to firms in relation to aggregate measures of insider trades over well-defined periods (Cohen et al., 2012), and therefore they do not permit to evaluate whether their trades are in line with trading in anticipation of future relevant information that has not yet been revealed to the public. Furthermore, these findings are generally more consistent with insider purchases as insiders could sell for other reasons, such as liquidity or diversification.

Other papers document that insiders use their foreknowledge of material information when trading by showing that they make profitable trades in a contrarian fashion in anticipation of future corporate events not yet disclosed to the market (Noe, 1999; Ke et al., 2003; Cheng et al., 2007). However, the reasons behind their contrarian trading pattern are also challenged in the literature. For example, Jenter (2005) argues that managers may not use much valid inside information in their decisions above and beyond the information

contained in observable firm characteristics such as size and book-to-market. This stream of the literature argues that insiders trade on mispricing and so on different interpretation of already disclosed information (Sivakumar and Waymire, 1994; Rozeff and Zaman, 1998; Piotroski and Roulstone, 2005; Jenter, 2005). Piotroski and Roulstone (2005) show that insider trades are consistent with both views, that is, trading on foreknowledge of future firm's performance and trading against current investors' sentiment, although their evidence is stronger for the second view.

More recently, Kolasinski and Li (2010) and Alldredge and Cicero (2015) argue that insiders are skillful investors who interpret new public information better than the rest. Similarly, we argue that insiders' motivation to sell at the earnings announcements comes for their ability to better analyze the fundamental information contained in the news and take advantage of situations when the market misinterprets it. Insiders sell when market sentiment is high during earnings announcements and stock prices deviate away from firms' fundamental values.

Miller (1977) shows that stocks are more overpriced when investors' opinions about firm's value diverge more, provided that short sales constraints are binding. This is because with high divergence in investors' opinions and binding short sale constraints, stock prices reflect valuations of the most optimistic investors who push the demand for the stock up and so cause overpricing. As a result of the overpricing, stock prices drop in the future. Underpricing, in contrast, is not explicit under Miller's model and so it's difficult to establish an association between divergence in investors' opinions and undervaluation under his framework.

We conjecture that insiders recognize and take advantage of mispricing as a

result of high market sentiment originated in the earnings announcements and so insider trading is associated to changes in divergence in investors' opinion upon the news release. Therefore, the main hypothesis of this chapter is that insiders are more likely to sell shares of their firms after earnings announcements that are associated with an increase in divergence in investors' opinions and binding short sale constraints. In contrast, we predict insiders buying less or not buying at all in stocks with these characteristics.

Miller's model has been extensively tested.[7] Berkman et al. (2009) is the closest to our analysis as they test the model in a context of earnings announcements. They show that stocks with higher divergence in investors' opinions and higher short sale constraints before the earnings announcements earn significantly lower returns upon release of the earnings news (3 days around the earnings announcement). They argue that this result is consistent with Miller's (1977) model, as stocks with high disagreement and binding short sale constraints prior to the announcement date are more prone to be overpriced and, therefore stock prices should adjust back to fundamental values as a result of the news. This price adjustment then is expressed as lower earnings announcements abnormal returns.

One important assumption embedded in Berkman et al. (2009) analysis is that the release of information in the earnings announcements reduces divergence in investors' opinions. In contrast with this assumption, Brown et al. (2009) suggest that public information such as earnings announcements not only attracts investors' attention, but also increases divergence in investors' opinions. Kim and Verrecchia (1994) and Brown et al. (2009) argue that quar-

[7]See for example Diether et al. (2002); Goetzmann and Massa (2005); Boehme et al. (2006); Banerjee (2011)

terly earnings announcements allow investors to make their own judgements about firms' value and, therefore, to generate their own private information. The interaction between investors' prior beliefs and a new public signal might result in investors disagreeing about the interpretation of the news and therefore divergence in investors' opinions might increase rather than decrease following earnings announcements (Barron et al., 2005; Fleming and Remolona, 1999; Kim and Verrecchia, 1997; Lee et al., 1993).

2.2 Data

By law, US corporate insiders must report their transactions in the company stock with the SEC by filing forms 3, 4 and 5 specified by the Security Exchange Act of 1934. Thomsom Financial Insider Filings contain all insider activity as reported in the forms. It covers detailed information about the transactions and the insiders including the trading date, announcement date, insider's name and role in the firm, number of shares traded, transaction price and transaction type (purchase or sale).

Our sample covers 11 years of insider transactions from Thomsom Financial Insider Filling. We start our data set as of January 2003 to include only insider transactions that are reported under the more timely new rules of the Sarbanes-Oxley Act of 2002.[8] The last year covered is 2013. We merge all transactions within one day of the same director in the same direction (purchases/sales), but keep transactions if in different direction even on the same day. In total, we have 479,957 individual insider transactions split between purchases and sales. Our analysis is built around earnings announcements and so we associate

[8]Since August 2002 the Sarbanes-Oaxley Act accelerated the reporting deadline for insider ownership reports to no more than 2 days after the transaction date.

every insider transaction to a quarterly earnings announcement. We denote the period between 2 earnings announcements as a quarter and aggregate all insider transactions on this quarterly level. Figure 2.1 shows our setup, timings and notation. We denote the two earnings announcements at the beginning and end of the current quarter as EA_0 and EA_1, respectively. We classify each firm-quarter as one of the following types: (i) without any insider trading (*No IT*), (ii) containing only insider purchases (*Only P*), (iii) containing only insider sales (*Only S*) and (iv) containing both insider purchases and sales (*Mix*).

Insert Figure 2.1 about here.

Our data set includes all firm-quarters with data available in COMPUSTAT. Stock and market returns are downloaded from CRSP and the benchmarks for size and B/M portfolio returns are downloaded from Kenneth French's web page. Other firm characteristics we use are firms' size, book to market, earnings surprises and past returns which are all defined in the Appendix. We calculate abnormal returns at the earnings announcement date and after a quarterly earnings announcements (See Figure 2.1). We use the 4 factor model (Carhart, 1997) as a benchkmark and measure abnormal returns as the buy-and-hold cumulative abnormal over the period of interest: $BHAR_{i,t} = [\Pi_{t=t_1}^{t_2}(1+R_{i,t})-1] - [\Pi_{t=t_1}^{t_2}(1+E(R_{i,t})-1)]$, where $\mathrm{R}_{i,t}$ is the realized return on day t.[9]

[9]We also use the 3 factor model Fama and French (1992) and the market model for robustness purposes and the results remain unchanged.

2.2.1 Measuring divergence in investors' opinions and short sale constraints

Measuring divergence in investors' opinions represents a challenge (Berkman et al., 2009). The variable most widely used in the literature so far is dispersion in analysts' forecasts derived from the Institutional Brokers Estimates System (I/B/E/S). However, there are important drawbacks associated with this variable. First, dispersion in analysts' forecasts is an indirect measure as it reflects divergent opinions of analysts rather than investors (Bamber et al., 2011; Diether et al., 2002). Second, small firms are generally not covered by many analysts, which might imply important biases of the measure. In fact, smaller firms suffer higher information asymmetries, thus, earnings announcements in smaller firms might be associated with stronger investors' reaction and divergence of opinions. Finally, and importantly for our analysis, the measure does not allow to capture divergence in investors' opinions during the short window of earnings announcements. Analysts' forecasts reflect expectations concerning the earnings news and so the measure captures analysts' divergence before the earnings announcement rather than the effect on investors' disagreement as a result of the news publication. We are more interested in the latter rather than the former.

To overcome these issues, we borrow a measure from the market microstructure literature and use daily order imbalance proposed by Aktas et al. (2007). During earnings announcements when investors' valuations of firms diverge, this disagreement is reflected in the form of imbalances between buy and sell orders as investors trade on the basis of their information (Brown et al., 2009). Daily order imbalance ($OIBvol$) is the absolute value of the difference between

the volume of buyer initiated versus seller initiated trades made during one trading day, scaled by the total volume on the trading day:

$$OIBvol_{i,t} = |Bvol_{i,t} - Svol_{i,t}|/(Bvol_{i,t} + Svol_{i,t}) \tag{2.1}$$

where $\text{Bvol}_{i,t}$ ($\text{Svol}_{i,t}$) stands for the daily number of shares bought (sold) for each firm i on day t. Intuitively, the lower the order imbalance, the closer is the volume of buyer versus seller initiated trades, which reflects high polarization and so high divergence in investors' opinion. We use high frequency data from NYSE Trades and Quotes database (TAQ) to extract the necessary intraday transactions. We apply the Lee and Ready (1991) algorithm to classify trades and quotes as buyer or seller initiated.

As we want to observe how changes in divergence in investors' opinions affect insiders decision to trade, we construct a measure of market adjusted order imbalance following a similar approach to Garfinkel and Sokobin (2006). First, we calculate daily order imbalance from 43 days before to 43 days after the announcement date. Second, we adjust it for a market-wide order imbalance defined as the equally weighted average order imbalance over all firms in our sample.[10] This calculation is as follows:

$$\overline{OIBvol}_{i,q(t_1,t_2)} = \left\{ \sum_{t=t_1}^{t_2} [OIBvol_{i,t} - OIBvol_{mkt,t}] \right\} \Big/ T \tag{2.2}$$

Where i, mkt, q and t represent a firm, the market, a quarter and a day around an earnings announcement date respectively ($t = 0$ is the earnings

[10] We also calculate market order imbalance as the value weighted *OIBvol* for all the firms in our sample 43 days before and after the earnings announcements date. The results remain the same.

date as reported on COMPUSTAT). T is the number of days for which we are computing the average. We define three important periods around the announcement date which outline the final step in the construction of the measure: (i) (-4,+1) is our earnings announcement window, (ii) (-14,-5) as the pre-earnings announcement window, and (iii) (-43,-15) as the non-event window. Our announcement window starts 4 days before to take into count the run-up period where investors could trade in the direction of the news.[11] Hence, $\overline{OIBvol}_{(-4,+1)i,q}$ corresponds to the average daily market adjusted order imbalance at the earnings announcement period in quarter q for firm i. We also consider a pre-earnings announcement period to control for Berkman et al. (2009) findings. Furthermore, although our definition for a non-event window may look arbitrary, we believe is a reasonable period considering that on average no relevant information would affect every firm at the same time during this period.

For our last step, we acknowledge that firms with high level of disagreement at the earnings announcement may reasonable have a high level of disagreement overall. So, $\overline{OIBvol}_{(-4,+1)i,q}$ may be capturing general cross sectional differences across the firms in our sample that are not attributable to investors' response to the earnings announcements. Hence, we subtract from the daily market adjusted order imbalance at the earnings announcements (-4,+1) and at the pre-earnings announcement period (-14,-5) the whole sample daily market adjusted order imbalance at the non-event window (-43,-15). Equations 2.3

[11] We also run all our results by computing changes in order imbalance at the window (0,+1) and the results are a little weaker in magnitude, but the association is the same.

and 2.4 describes the procedure:

$$\Delta OIBvol_{(-4,+1)i,q} = \overline{OIBvol}_{(-4,+1)i,q} - \overline{OIBvol}_{(-43,-15)i} \quad (2.3)$$

$$\Delta OIBvol_{(-14,-5)i,q} = \overline{OIBvol}_{(-14,-5)i,q} - \overline{OIBvol}_{(-43,-15)i} \quad (2.4)$$

As for the raw order imbalance, intuitively, the lower the changes in order imbalance reflect an abnormal increase in divergence in investors' opinion during the period contrasted. ΔOIBvol$_{(-4,+1)i,q}$ and ΔOIBvol$_{(-14,-5)i,q}$ constitute our main measures of divergence in investors' opinions that we use throughout the chapter. However, in order to validate order imbalance as a measure that indeed captures divergence in investors' opinion, we also use dispersion in analysts' forecast as a benchmark. Dispersion in analysts' forecasts is the standard deviation of quarterly earnings per share forecasts for the current earnings announcements that are issued in the period between the last earnings announcements and two days prior to the current earnings announcement date, divided by the absolute value of the median analyst forecast.

To measure short sale constraints we employ two variables used in the literature. First, as institutional investors provide the majority of stock lending in the market, firms with low institutional ownership have low supply of stocks available for lending and, therefore, should have higher short sale constraints (Berkman et al., 2009). Institutional ownership (INSOWN) is defined as the fraction of shares held by institutional investors prior to the earnings announcement scaled by the number of shares outstanding. We get institutional ownership data from FactSet.

The second measure we employ is relative short interest (RSI) defined as the level of short interest for a firm in a certain month scaled by its number

of shares outstanding. Short interest corresponds to the monthly quantity of shares that are held short for a given firm, as a result, RSI is the percentage of each firm's shares that are held short. Intuitively, the higher is the level of shares shorted for a stock, the higher is the unobserved demand for shorting it as well (Figlewski, 1981; Boehme et al., 2006). This means that stocks with higher levels of relative short interest are more difficult to short in the margin, so they are more likely to have binding short sale constraints.[12]

2.2.2 Summary Statistics

Table 2.1 shows the spread of insider transactions across quarters in our sample. We see that insiders are quite active shortly after earnings news. Around 60% of all insiders transactions in our sample take place within the first month after earnings announcements and about 30% of all transactions occur within the first 10 trading days. This pattern is consistent with insiders concentrating their trading after the earnings are released to the public to minimize legal jeopardy (Huddart et al., 2007).

Insert Table 2.1 about here.

Table 2.2 summarizes differences across quarters types by insider trading. Panel A shows that we have 170,296 firm-quarters in our sample, from which 73,783 (43.33%) have no insider transactions (*No IT*) and 96,513 (56.67%) have at least one insider trade. Quarters with insider sales only (*Only S*) are

[12]Despite these arguments, one might state that a stock with high levels of observed short interest must be relatively unconstrained rather than highly constrained. Boehme et al. (2006) provide an exhaustive analysis examining the empirical relation between RSI and the stock lending fees and find a large positive correlation between them. As firms with higher levels of short interest also exhibit higher lending fees, they conclude that stocks with high levels of short interest are more difficult to short in the margin. Therefore, these firms must have more binding short sale constraints.

relatively frequent compared to purchases (*Only P*). While 33.36% of quarters contain only insiders sales, 13.4% only purchases. Quarters with mix of insiders' purchases and sales (*Mix*) are less frequent (9.91% of quarters). Also, on average insiders sell more shares than they buy. The relative number of shares per-quarter they sell is 0.6% as opposed to 0.45% they purchase.

In Panel B, the overall average dispersion in analysts' forecasts (*DISP* in column 1) is very similar to Berkman et al. (2009). However, we see important differences in firm characteristics across the quarters. First, *No IT* and *Only P* have relatively higher *DISP* than quarters with *Only S* and *Mix* suggesting that quarters where insiders buy versus sell have higher disagreement prior an earnings announcements. This is not reflected by the level of order imbalance pre-earnings announcement ($\overline{OIBvol}_{(-14,-5)}$) which is the highest in quarters with purchases suggesting agreement among investors. Also, it remains the highest during the earnings announcements ($\overline{OIBvol}_{(-4,+1)}$). For *Only S* quarters, in contrast, order imbalance is the lowest both prior ($\overline{OIBvol}_{(-14,-5)}$) and during the earnings announcements ($\overline{OIBvol}_{(-4,+1)}$) indicating higher disagreement.

Insert Table 2.2 about here.

Second, our measure of changes in market adjusted order imbalance decreases for all quarters during earnings announcements suggesting that divergence in investors' opinion increases upon the news release (a decrease in $\Delta OIBvol_{(-4,+1)}$). Also, while *Only S* quarters exhibit the largest increase, *Only P* quarters show the lowest. Importantly, this is in line with the argument that earnings announcements could increase rather than reduce investors' disagreement as their interpretation of the same piece of information may differ

significantly (Kandel and Pearson, 1995; Brown et al., 2009; Engelberg et al., 2012). Finally, $\Delta OIBvol_{(-14,-5)}$ shows that the overall disagreement decreases before the news and decreases even more in *Only P* quarters. The opposite stands in *Only S* and *Mix* quarters. Therefore, while for *Only S* quarters the level of disagreement is higher before and during the news, for *Only P* quarters is lower. This reinforces the need of using changes for these measures relatively to a non-event window as we do.

Further, the average firm in our sample has a market capitalization of USD 2,656 million. In line with the literature, insiders sell more on larger firms and buy more in smaller firms (Piotroski and Roulstone, 2005). Similarly, book to market ratio indicates that insiders sell high valuation firms (growth firms) and buy low valuation firms (value firms) (Rozeff and Zaman, 1998; Jenter, 2005). Looking at the stock returns in Panel C, we see the contrarian behavior of insiders documented in the literature. Insider sale quarters exhibit higher past returns, positive news at the current quarter (marked by EA_0) and lower future returns. In contrast, insider purchase quarters show lower past returns, a negative market reaction and higher future returns.

2.2.3 Order imbalance vs. dispersion in analysts' forecasts

In this section we aim to validate order imbalance as a measure of divergence in investors' opinion. We perform 2 tests. First, we replicate Berkman et al. (2009) to check order imbalance relative to dispersion in analysts' forecasts in capturing divergence in investors' opinion in the context of earnings announcements. Second, we examine the cross-sectional variation in post-earnings an-

nouncements returns by different levels of order imbalance.

For the first test, we examine the association between divergence in investors' opinion and abnormal returns in the three days around earnings announcements. While controlling for short sale constraints and other variables that could be associated to earnings announcements abnormal returns. The model we test is as follows:

$$\begin{aligned} EA_0 abnormalret_{i,q} = \alpha_{i,q} + \beta_1 DIVG_{i,q} + \beta_4 SHSC_{i,q} + \beta_5 SIZE_{i,q} \\ + \beta_6 BtoMKT_{i,q} + \beta_7 \Delta EPS_{i,q} \\ + \beta_8 PastRET(1year)_{i,q} + \varepsilon_{i,q} \end{aligned} \tag{2.5}$$

Where i identifies a firm and q a quarter. *DIVG* stands for divergence in investors' opinions comprising the 3 measures we have and use interchangeably across the specifications: (i) dispersion in analysts' forecasts (DISP), (ii) changes in order imbalance prior to the announcement ($\Delta OIBvol_{(-14,-5)}$) and (iii) changes in order imbalance during the earnings news ($\Delta OIBvol_{(-4,+1)}$). *SHSC* refers to the 2 measures for short sale constraints: (i) institutional ownership (*INSOWN*) and (ii) relative short interest (*RSI*). We estimate this model by performing a pooled OLS regression and then by controlling for firm and time fixed effects. All variables are standardized by subtracting their mean and scaling them by their standard deviation to determine the relative association of the individual explanatory variables on the earnings announcements abnormal returns. The results are reported in Table 2.3.

Insert Table 2.3 about here.

Columns 1 and 2 replicate Berkman et al. (2009) findings with the 2 alternative measures of short sale constraints. We see a significantly negative coefficient for dispersion in analysts' forecasts ($DISP$) and relative short interest, along with a significantly positive coefficient for institutional ownership ($INSOWN$). Thus, market reaction to earnings announcements is lower in quarters with high divergence in investors' opinions before earnings announcements and more binding short sale constraints.[13] Berkman et al. (2009) argue that this result is consistent with Miller's (1977) model because stocks with high disagreement and binding short sale constraints before earnings announcements are more prone to be overpriced. As result, stock prices adjust downwards upon the news release.

In columns 3 and 4 we replace dispersion in analysts' forecast ($DISP$) with our 2 order imbalance measures. We see that, consistent with Berkman et al. (2009), the coefficient for $\Delta OIBvol_{(-14,-5)}$ is positive and significant while $INSOWN$ and RSI remain almost unchanged relative to columns 1 and 2. Higher divergence in opinions among investors before earnings announcements (lower $\Delta OIBvol_{(-14,-5)}$) is associated with lower market reaction to the earning news. We also include $\Delta OIBvol_{(-4,+1)}$ measuring investors' divergence in opinions during earnings announcements and see that increases in disagreement (a reduction in $\Delta OIBvol_{(-4,+1)}$) due to the publication of earnings are associated with higher earnings announcements abnormal returns. This result supports the view that earnings announcements could increase investors' disagreement (Brown et al., 2009; Kim and Verrecchia, 1997) which is central to our hypoth-

[13]Recall that intuitively stocks with lower $INSOWN$ have more binding short selling constraints. The opposite, however, works for RSI therefore we expect a negative coefficient for $INSOWN$ and a positive coefficient for RSI.

esis.[14]

In columns 5 to 8 we re-run the same specifications as in columns 1 to 4, but now controlling for firm and time fixed effects. The inclusion of fixed effects has an important effect on the coefficient for dispersion in analysts' forecasts ($DISP$). Even though the negative coefficient remains its statistical and economic significance drops remarkably. Also, the coefficient for institutional ownership ($INSOWN$) changes sign and becomes significantly negative, while the coefficient for relative short interest (RSI) keeps its sign and significance and increases a little in magnitude (column 6). These results highlight the inclusion of fixed effects to estimate the specifications as time invariant effects could bias the estimation of the coefficients in the model.[15] Finally, we see that our order imbalance measures $\Delta OIBvol_{(-4,+1)}$ and $\Delta OIBvol_{(-14,-5)}$ in columns 7 and 8 remain with the expected sign and significance even when including firm and time fixed effects.

In our second test, we examine monthly returns on calendar time portfolios formed by sorting stocks at different levels of order imbalance. If order imbalance reasonably captures divergence in investors' opinions, stocks with lower levels of order imbalance (higher divergence in investors' opinions) should earn lower future returns. To do this, each quarter we assign stocks into five portfolios based on quintiles of average changes in order imbalance at different time windows, and hold them in the portfolios for 1, 3, 6 or 12 months after the

[14]However, it goes against Berkman et al. (2009) assumption that divergence in investors' opinions decreases once earnings news is released.

[15]The inclusion of fixed effects produce significant differences relative to the results documented by Berkman et al. (2009). One difference is that they estimate their model using Fama and McBeth regressions. However, running the specifications using Fama and McBeth produce almost identical results to our pooled OLS in columns 1 to 4. Fixed effects control for the time invariant component of dispersion in analyst's forecasts. Once this fixed component is eliminated the association of this variable and earnings announcements abnormal returns disappears.

earnings announcement EA_1 (see Figure 2.1).[16] We calculate portfolio returns in a given month as an equally-weighted average of returns of all stocks in the portfolio. We only include stocks that have non-missing price at the end of each quarter and have stock price greater than \$5 at portfolio formation. This criterion ensures that returns are not driven by illiquid stocks (Cohen and Frazzini, 2008). Finally, we compute Jensen's alpha from a time-series regression that regress monthly excess returns of a long-minus-short portfolio strategy on the 3 Fama and French (1993) factors and the Carhart (1997) momentum factor.

Table 2.4 shows Jensen's aphas for trading strategies of a zero-cost portfolio that holds long stocks at the top quintile of changes in order imbalance and sells short stocks at the bottom quintile. Intuitively, stocks in the bottom quintile of changes in order imbalance exhibit larger increases in divergence in investors' opinions and, therefore are more prone to overpricing. This investment rule should earn zero abnormal returns in an efficient market.

Insert Table 2.4 about here.

In general, we find that this strategy gives positive abnormal returns at the different time horizons. That is, after controlling for the size, book to market ratio and momentum factors, stocks with a large increase in disagreement (bottom quintile of $\Delta OIBvol$) around the earnings announcements tend to have lower future returns than do stocks with a reduction in disagreement (top quintile of $\Delta OIBvol$). In particular, we see that a long-short strategy based on

[16] We start calculating portfolio returns after EA_1 instead of EA_0 because of 2 reasons: (1) our setup aggregates insider trading to a quarter and, therefore, we allow for the market to adjust to their trades. (2) According to Miller (1977), usually disagreement narrows over time, as new information comes and uncertainty is resolved, but it takes the market some time adjust to it.

changes in order imbalance in the 5 days around the earnings announcements (-4,+1) generates an average 1.1% monthly abnormal returns at 1, 3, 6 and 12 months after EA_1.[17] Similarly, a long-short strategy based on changes in order during the earnings announcements (0,+1) generates an average 0.4% to 0.6% monthly abnormal returns at 3, 6 and 12 months after EA_1.

Overall, these results not only validate order imbalance as a good measure of divergence in investors' opinions, but also expand Berkman et al. (2009) evidence. On the one hand, we show consistency with their main results where high divergence in investors' opinions before earnings announcement is associated with lower returns on average at the announcement date (positive coefficient of $\Delta OIBvol_{(-14,-5)}$). On the other hand, however, we provide new evidence showing that an increase in disagreement during the earnings announcements is associated with higher market reaction to the news (negative coefficient of $\Delta OIBvol_{(-4,+1)}$). Therefore, we believe there are big advantages in using order imbalance which is its precise timeliness that allows us to distinguish between investor's divergence in opinions before versus during the earnings announcements and so test their different effect on earnings announcement abnormal returns.

[17] These results are consistent with the findings of Diether et al. (2002). They show that a portfolio of stocks in the highest quintile of disagreement, measured through dispersion in analysts' forecasts, under-performs a portfolio of stocks in the lowest quintile of that measure. Our setup is slightly different as our sample is structured around earnings announcements, but both findings are in the same direction.

2.3 Results

2.3.1 Determinants of insider trading after earnings announcements

In this section we test whether insiders adjust their trading strategies in response to divergence in investors' opinions originated in the earnings announcements. In particular, we aim to determine which set of factors predict insider trading activity in each quarter after earnings are made public. We do this in a regression framework that takes each quarter type as the dependent variable and our measures of divergence in investors' opinions as explanatory variables. The model we test is as follows:

$$\begin{aligned} OUTC_{i,q} = \alpha_{i,q} &+ \beta_1 \Delta OIBvol_{(-4,+1)i,q} + \beta_2 \Delta OIBvol_{(-14,-5)i,q} \\ &+ \beta_3 RSI_{i,q} + \beta_4 EA_0 abnormalret_{i,q} + \beta_5 SIZEi, q \\ &+ \beta_6 BtoMKTi, q + \beta_7 \Delta EPS_{i,q} \\ &+ \beta_8 PastRET(1year)_{i,q} + \varepsilon_{i,q} \end{aligned} \tag{2.6}$$

Where $OUTC_{i,q}$ is each a categorical variable representing each of the outcomes for insider trading (*Only S*, *Only P*, *Mix* and *No IT*) as described in section 2.2. All the other variables are defined in the Appendix. To estimate this model we use a multimonial logistic regression as it fits our set-up the best. We take no insider trading (*No IT*) as the reference category and, therefore, report three sets of regression coefficients: for purchase, sale and mixed quarters. They have to be interpreted relatively to a *No IT* quarter. In all

specifications, we also include year dummies, but we do not report them to save space. We compute robust standard errors and allow them to cluster within firms. In order to determine importance of the individual explanatory variables for predicting insider trading, we standardize the explanatory variables by subtracting their mean and scaling by their standard deviation. The standardization means that the units of the regression coefficients are now the same and therefore are directly comparable across variables. The results are reported in Table 2.5.

Insert Table 2.5 about here.

Panel A contains the base model, without including our order imbalance measures and relative short interest. The results confirms the well established finding in the literature of insiders contrarian behavior when trading (Sivakumar and Waymire, 1994; Rozeff and Zaman, 1998; Piotroski and Roulstone, 2005; Jenter, 2005). In particular, more positive past returns and changes in earnings per share increase the odds of insiders selling and decrease the odds of insiders buying in a given quarter. Similarly, while insiders are more likely to sell when the market reaction to earnings announcement is higher, they are more likely to buy when the market reaction is lower. Also, the book to market ratio indicates that insiders are more likely to sell (buy) high (low) valuation stocks, which is in line with Jenter (2005) results. Moreover, insiders sell more often in large firms and buy in small firms which has been also widely documented in the literature. The last column shows that mix quarters are common for larger firms and resembles pure sale quarters, however, all the coefficients are weaker.

In Panel B we add the order imbalance measures and *RSI* as explanatory

variables. We see that $\Delta OIBvol_{(-4,+1)}$ significantly affects the odds of insider selling but not buying. As expected an increase in divergence in investors' opinions, expressed as reduction in $\Delta OIBvol_{(-4,+1)}$, significantly increases the likelihood of insiders selling. Also, $\Delta OIBvol_{(-14,-5)}$ doesn't predict insider trading activity at all, suggesting that changes in disagreement in the pre-earnings announcement period doesn't play any role for insiders' decision to trade. The coefficient for *RSI* is significantly positive for sale quarters and negative but insignificant for purchases, indicating that short sale constraints increase the odds of insiders selling but not buying.

Lastly, in Panel C we add institutional ownership (*INSOWN*) as a measure of short sale constraints and the results remain almost unchanged relatively to Panel B. However, the coefficient for *INSOWN* is significantly positive for sale quarters, which contradicts the results for *RSI* in Panel B and goes against our predictions.[18] In our view, this result strongly indicates that *INSOWN* is correlated with insider sales for reasons other than short sale constraints around earnings announcements. In fact, *INSOWN* is significantly and positively correlated with firm's size in our sample. The large drop in the coefficient for firms' size in Panel C confirms this.[19] Insiders sell in larger firms where institutional ownership is higher and, therefore, *INSOWN* may not be such a good measure of short sale constraints in our setup. Moreover, data for *INSOWN* is quarterly and, therefore, it has less variation compared to relative short interest *RSI*, which constitutes a very relevant drawback to test our hypothesis. These results along with the evidence in Table 2.3 indicate, in our view, that

[18] A positive coefficient for *INSOWN* indicates that insiders are more likely to sell after earnings news in stocks with high institutional ownership, that is, stocks with lower short sale constraints.

[19] The correlation coefficient is around 60% and significant at 1% level for quarters with insider sales.

INSOWN is not a good proxy for short sale constraints in the short window of earnings announcements. Therefore, in the following analysis we center our attention on *RSI*.

Importantly, the results in Panel A and B show consistency with our conjecture of insiders selling in response high market sentiment during earnings announcements. That is, insiders are more likely to sell shares on stocks experiencing an increase in divergence in investors' opinion over the news release and more binding short sale constraints. As for purchases, neither changes in order imbalance during and prior the earnings announcements date nor *RSI* seem to affect insiders likelihood of buying, suggesting that insiders do not tend to buy in response to overvaluation.

2.3.2 Future returns

In the previous section we show that indeed insiders sales are associated with high divergence in investors' opinions originated in the earnings announcements. Even when this association suggests that insiders are more likely to sell stocks that become overvalued after the publication of earnings, this evidence doesn't constitute a definite proof for this prediction by itself. If insiders sell overpriced stocks in a given quarter, these firms should earn lower future returns afterwards. To test this hypothesis we employ the calendar time portfolios analysis and sort stocks according to the order imbalance measures conditioning on insider trading.

As in section 2.2.3, we construct portfolios by quintiles of order imbalance around the earnings announcements, but now we also condition on stocks where insiders sell or buy in a given quarter. Specifically, the strategies we

evaluate are the following: (1) go long in stocks with no insider trading in a given quarter and sell short stocks with only insider sales across different quintiles of changes in order imbalance during the earnings announcements, and (2) hold stocks with only insider purchases across different quintiles of changes in order imbalance during the earnings announcements and sell short stocks with no insider trading in each quarter. If insiders do trade in overpricing generated by disagreement over the earnings announcements, they should earn higher abnormal returns in lower order imbalance quintiles when selling and highest order imbalance quintiles when buying.

Insert Table 2.6 about here.

Table 2.6 reports Jensen's alphas for these strategies. For the first strategy Jensen's alphas are higher in lower $\Delta OIBvol_{(-4,+1)}$ quintiles for all time horizons. Also, alphas are consistently the highest for the first quintile, which marks stocks that exhibit the higher divergence in investors' opinions and, therefore, are more prone to be overpriced. The alphas then monotonically decrease for the remaining quintiles. This result indicates that a simple strategy of buying stocks with no insider trading and shorting stocks with insiders sales after earnings announcements generate positive abnormal returns, but especially for stocks that exhibit a higher increase in divergence in investors' opinions during the earnings announcement. This pattern in returns shows consistency with our conjecture of insiders selling stocks that have become overpriced as a result of an increase in divergence in investors' opinions during the earnings announcements.

In sharp contrast, a trading strategy based on insider purchases is associated with positive and significant abnormal returns only for the highest quintile

of order imbalance and over longer horizons. The significantly positive coefficient for quintile 5 indicates that insiders earn significantly higher returns buying stocks that exhibit a reduction in disagreement during the earnings announcements. We consider these stocks as the least likely to be overpriced and therefore, this result is consistent with our conjecture that insiders are buying less in response of overpricing. However, the fact that by buying these stocks insiders are able to earn higher returns may suggests that a subset of insiders are purchasing in response to undervaluation. In line with this argument, Kolasinski and Li (2010) show that insiders buy more shares in stocks that underreact to positive news than in stocks that underreact to negative news.

2.3.3 Intensity of insider trading.

In this section we explore insider intensity for trading after earnings announcements. We conjecture that insiders trade more shares of their company's stocks when investors' opinions diverge more as a result of the news. We use the average number of shares traded by insiders ($Relsharestr_{i,q}$) in a given quarter as our dependent variable and we scaled by the number of shares outstanding. We include only quarters with insider sales or purchases because we are interested in quarters where insiders provide a clear signal with their trades. As a consequence, our dependent variable in column 1 takes the form of a response variable which is greater than 0 in quarters with only insider sales and zero otherwise. The same applies for quarters with only purchases in column 2. Therefore, we estimate our model as Tobit. The independent variables ($X_{i,q}$) are the same as in equation 2.6 and they are defined in the Appendix. The

model we test is as follows:

$$\begin{aligned} Relsharestr_{i,q}^{(OnlyS,OnlyP)} &= \alpha_{i,q} + \beta_1 \Delta OIBvol_{(-4,+1)i,q} \\ &+ \beta_2 \Delta OIBvol_{(-14,-5)i,q} + \beta_3 SHSC_{i,q} \\ &+ \beta_4 X_{i,q} + \varepsilon_{i,q} \end{aligned} \tag{2.7}$$

Table 2.7 reports results. For sale quarters (column (1) of Table 2.7), the negative coefficient for $\Delta OIBvol_{(-4,+1)}$ indicates that insiders tend to sell more shares in firms that experience a larger increase in divergence in investors' opinions during the earnings announcements (a reduction in $\Delta OIBvol_{(-4,+1)}$). Insiders do not only sell more often but also tend to sell more shares when investors disagree more on the interpretation of the earnings news. For purchase quarters, in contrast, the coefficient for $\Delta OIBvol_{(-4,+1)}$ is positive and weakly significant. Insiders tend to buy less shares the increase in disagreement during earnings announcements is larger, which is consistent with our conjecture that insiders buy less when their firms are more prone to overpricing. The coefficient for *RSI* is significantly positive in quarters with sales suggesting that insiders sell more intensively in firms with more binding short sale constraints. Although the coefficient for *RSI* is also positive and significant for purchases quarters, the magnitude is larger for sale quarters.

Insert Table 2.7 about here.

2.4 Investors' attention

Miller (1977) argues that overvaluation could also occur because some stocks attract investors' attention more than others and, as a result, stock prices reflect valuations of the more optimistic investors who investigate about the stocks. One type of public event that usually attracts investors' attention is the earnings announcement. Brown et al. (2009) argue that earning surprises usually capture attention from the media making stocks more visible to individual investors. Higher visibility increases the set of potential buyers but not necessarily the set of potential sellers, which result in higher stock prices (Barber and Odean, 2008). In line with this idea, Hirshleifer and Teoh (2003) show that individual investors are net buyers after positive news and Hou et al. (2009) find that individual investors' attention can intensify market overreaction after earnings announcements.

Accordingly, we conjecture that insiders are more (less) likely to sell (buy) in quarters with an increase in investors' attention during earnings announcements. We measure investors' attention in two ways. First, trading volume is likely to be higher than usual when news reaches investors (Barber and Odean, 2008), so we take changes in daily turnover during the earnings announcements as the first measure of investors' attention (ΔTO). We take the average number of shares traded two days around the earnings announcements $(0, +1)$ scaled by the number of shares outstanding and adjust it relatively to the period prior to the earnings announcement (from days -30 to -5).

For the second measure of investors' attention we follow Brown et al. (2009) who argue that positive earnings surprises get a considerable amount of attention from the media making stocks more visible for individual investors. As a

result, firms that beat analysts' forecasts represent attractive buying opportunities for individual investors who are more likely to purchase them. We define *Beat* firms as a binary variable equal to 1 if the reported earnings per share for the current quarter is greater than the consensus analysts' forecasts and 0 otherwise. The consensus in analysts' forecasts is measured as the median earnings per share predicted by analysts in the period prior to the earnings announcements. Consequently, we test the following model:

$$\begin{aligned} OUTC_{i,q} = \alpha_{i,q} &+ \beta_1 EA_0 abnormalret_{i,q} \\ &+ \beta_4 ATT_{i,q} + \beta_7 SIZEi,q + \beta_7 BtoMKTi,q \\ &+ \beta_9 PastRET(1year)_{i,q} + \varepsilon_{i,q} \end{aligned} \tag{2.8}$$

Where i identifies a firm and q a quarter. The framework is the same as in Section 2.3.1 where we analyze factors that predict insider trading, but here we add the attention measures as the main explanatory variable instead of order imbalance. As before $OUTC_{i,q}$ is a categorical variable representing the 4 possible outcome quarters: (i) no insider trading (No IT), (ii) only insider sales (Only S), (iii) only insider purchases (Only P) and (iii) both insider purchases and sale (Mix). The remaining variables are defined in the Appendix. As in the previous section we estimate this model using multinomial logistic regression and take no insider trading (No IT) as the reference category. The results are reported in Table 2.8.

Insert Table 2.8 about here.

in line with our predictions, insiders are more likely to sell when investors'

attention is high. In particular, Panel A shows the specification including changes in daily turnover (ΔTO) as the measure of attention. The positive and significant coefficient for ΔTO indicates that an increase in turnover during the earnings announcements rises the odds of insiders selling in the current quarter. The results in in Panel B are similar to Panel A when we include firms' beating analysts' forecasts (*Beat*). More specifically, insiders are more likely to sell on quarters when their firms beat the analysts' forecasts. Furthermore, for purchases quarters in column 2 the coefficient for ΔTO is insignificant and the coefficient for *Beat* is significantly negative suggesting that insiders are less likely to buy when their firms become overpriced during earnings announcements.

2.5 Could insiders be selling on foreknowledge?

A stream of the literature argues that insiders trade on foreknowledge in anticipation of events that revert firms' future performance (Ke et al., 2003; Piotroski and Roulstone, 2005; Cheng et al., 2007). We believe this is unlikely in our setup as we show that a large fraction of insider sales occurs during the first month after earnings announcements, and so it's hard to justify that their trades are based on information other than the news. However, one could argue that insiders in possession of a negative future information could delay their sales to moments when they rise less suspicion about trading on material information, such as after the earnings announcements. Also, our calendar portfolio analysis in Section 2.3 shows that stocks with insider sales exhibit significantly lower future returns, and this returns are long lasting even after 12 months. The fact that stock prices continue adjusting downwards may

also suggests trading on foreknowledge. Therefore, in the current section we provide an additional test to contrast this view.

Piotroski and Roulstone (2005) argue that insider trading on foreknowledge is consistent with trading on future fundamental information that could affect prices. Piotroski and Roulstone (2005) take changes in firm's returns on assets (ROA) as a measure of future fundamental information. We expect that if insider sales after earnings announcements are driven by foreknowledge, then there should be a negative association between quarters with only insider sales and future fundamental information. We take future return on assets (ROA) and future earnings per share (EPS), and we regress them on our categorical variable that indicates firm-quarter with insider sales only. More specifically, we take the cumulative return on assets (PostROA) and earnings per share (PostEPS) from the next quarter *(q+1)* until *(q+4)* as dependent variables. Additionally, we use changes on return on assets ($\Delta \text{ROA}_{q+1/q}$) and earnings per share ($\Delta \text{EPS}_{q+1/q}$) of the next quarter *(q+1)* relative to the current quarter *(q)*. We control for our divergence in investors' opinions measure. The results are in Table 2.9

Insert Table 2.9 about here.

We do not find evidence that insider sales are based on foreknowledge of future (one year ahead) cash flows. The positive and significant coefficient for *Only S* in columns (1) and (2) suggests that firms with insider sales in a given quarter have significantly higher *ROA* and *EPS* in the following 4 quarters relative to firms with purchases, mix or no insider trading. Similarly, in columns (3) and (4) firms with insider sales in a given quarter have significantly higher *ROA* and *EPS* in the next quarter.

The negative and significant coefficient for $\Delta OIBvol_{(-4,+1)}$ in column (1) indicates that firms with a large increase in divergence in investors' opinions during earnings announcements exhibit higher ROA in the following 4 quarters. Also, the negative coefficient for the interaction term shows that the association between $\Delta OIBvol_{(-4,+1)}$ and ROA is stronger in quarters with insider sales. Thus, stocks more prone to be overpriced during earnings announcements and stocks with insider sales are not necessarily less profitable afterwards, but still show lower future abnormal returns according to our results in Table 2.6. These results support our argument that insiders take advantage of market sentiment during earnings announcements. This is because prices adjust downwards for these firms even when future fundamental financial information is positive.

2.6 Conclusions

Insiders sales are generally less associated to foreknowledge of future material information than insider purchases. This is because insiders could sell for a variety of reasons, such as liquidity or diversification. One stream of the literature, however, highlights the contrarian nature of insider trading and argues that insiders time very well their transactions and trade against current investor sentiment by recognizing when their stocks are mispriced by the market (Sivakumar and Waymire, 1994; Rozeff and Zaman, 1998; Piotroski and Roulstone, 2005; Jenter, 2005). This means that insiders do not use much valid inside information when trading but the information that is already incorporated into stock prices.

The current chapter provides new evidence that insider sell against in-

vestors' sentiment by studying insider selling strategies during earnings announcements. We show that insiders sell more frequently and intensively on stocks that become more overpriced as a result of high market sentiment originated at the earnings announcements. In line with Miller (1977) model, we show that insiders sales are associated with an increase in divergence in investors' opinions and more binding short sale constraints. As a result of the overpricing, insider sales show predictability of future returns.

Our evidence has 3 parts. First, in an multinomial logistic regression predicting the odds of insider buying and selling we show that insiders are more likely to sell after earnings announcements that are associated with an increase in divergence in investors' opinions upon the news release. Additionally, the likelihood of insiders selling is higher for stocks with binding short sales constraints. Second, we show that the Jensen's alphas of trading strategies based on insider trading and divergence in investors' opinions are statistically and economically meaningful. Insider selling on mispricing after earnings announcements predicts future returns. Finally, insiders also sell more shares of their company's stocks to trade in situations where stocks become mispriced during the earnings announcements.

Overall, our results suggest that some profitable insider selling is motivated by public information (Kolasinski and Li, 2010; Alldredge and Cicero, 2015). Insiders can better interpret the information released in public news announcements and take advantage of situations when market misinterpret the news. By trading after the information is made public insiders not only trade profitable, but at the same time avoid legal jeopardy.

2.7 Appendix

Variable definitions

Variable	Definition	Source
ATT	Investors' attention over the earnings announcement. We measure investors' attention in two ways: (a) changes in daily turnover at the earnings announcements date ($\Delta TO_{(0,+1)}$). (b) A binary variable equal to 1 if the reported EPS in First Call for a given quarter is greater than the consensus analyst forecast the earnings announcement; and 0 otherwise. Daily turnover is computed as the average number of shares traded in the two days around the earnings announcements $(0, +1)$ scaled by the number of shares outstanding. Then, we determine changes in daily turnover relatively to the period prior to the earnings announcement (from trading day -30 to -5). The consensus analyst forecast is measured as the median of the EPS predicted by analyst forecast in the period before to the earnings announcements.	CRSP and I/B/E/S.
BtoMKT	Book value of equity corresponding to the previous quarter over the market cap 2 days before the earnings announcement.	COMPUSTAT
DISP	Dispersion of analysts' forecasts. Corresponds to the standard deviation of quarterly earnings per share (EPS) forecasts for the current earnings announcements that are issued in the period between the last earnings announcements and two days prior to the current earnings announcement date, divided by the absolute value of the median analyst forecast.	I/B/E/S
$EA_{0(1)}$ abnormal ret.	Buy and Hold abnormal stock return over 3 days $(-1, +1)$ around the earnings announcement date at EA_0 or EA_1 (See Figure 2.1). The abnormal returns are estimated as the difference between the observed return and the returns of a benchmark at that date. The 4 factors model is used as a benchmark which take into account the market risk along with size and book to market risk factors (Fama and French, 1992), and also includes momentum as risk factor (Cahart, 1997).	CRSP, French's web site
Future abnormal returns	Buy and Hold abnormal stock returns beginning 1 day after EA_1 adjusted for the 4 factor model which is used as the benchmark. Abnormal returns are computed over the horizons of 1, 3, 6 and 12 months, which corresponds to 22, 64, 128 and 265 working days.	CRSP, French's web site

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Variable	Definition	Source
INSOWN	Institutional ownership. It's measured as the fraction of the company's shares held by institutional investors prior to the earnings announcement, as reported in FactSet Ownership database. We set INSOWN to zero if no ownership data are available for a firm-quarter during the 180 days prior to the earnings announcement. We set INSOWN to missing if it is greater than ore qual to one.	FactSet
ΔOIBvol$_{(-4,+1)}$	Average changes in daily market adjusted order imbalance over 5 days around the earnings announcements $(-4, +1)$ relative to a non-event period (trading days -43 to -15). Order imbalance is the absolute difference between the the volume of buyer initiated trades versus seller initiated trades made over one trading day scaled by the total number of trades that trading day: $OIBvol = \|Bvol - Svol\|/(Bvol + Svol)$. Intuitively, the lower the order imbalance the higher the divergence in investors' opinions. Daily order imbalance is adjusted for a market-wide order imbalance defined as the equally weighted average order imbalance for all firms in our sample. We apply Lee and Ready (1991) algorithm to classify trades and quotes as buyer and seller initiated.	TAQ data
ΔOIBvol$_{(-14,-5)}$	Average changes in daily order imbalance in the period pre-earnings announcement relative to the period prior the publication of earnings (trading days -43 to -15). Order imbalance is the absolute difference between the the volume of buyer initiated trades versus seller initiated trades made over one trading day scaled by the total number of trades that trading day: $OIBvol = \|Bvol - Svol\|/(Bvol + Svol)$. Intuitively, the lower the order imbalance the higher the divergence in investors' opinions. Daily order imbalance is adjusted for a market-wide order imbalance defined as the equally weighted average order imbalance for all firms in our sample. We apply Lee and Ready (1991) algorithm to classify trades and quotes as buyer and seller initiated.	TAQ data
OUTC	Categorical variable that equals 0 for quarters without any insider trading (No IT), 1 for all quarters with insider sales only (Only S), 2 for all quarters with only insider purchases (Only P) and 3 for mixed quarters (Mix).	Thomsom Financial

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Variable	Definition	Source
PastRET(1 year)	Raw stock return over 1 year ending 2 days before the last earnings announcement date adjusted for 1-year returns over the same period on the corresponding to the value weighted portfolio as downloaded from CRSP database.	CRSP, French's web site
RSI	Stands for relative short interest ratio. Short ratio is the fraction of shares held short in the month of the earnings announcements (short interest) scaled by the number of shares outstanding.	CRSP
SIZE	The logarithm of the Market capitalization. The market cap is the stock price times the number of shares outstanding 2 days before the earnings announcement date.	COMPUSTAT

Table 2.1: Distribution of insider transactions in our sample per quarter type.

This table displays the number of insider transactions corresponding to the most recent earnings announcement relative to a given quarter. A quarter is marked as only insider sales (*Only S*) if all insider trades are sales for a given quarter, only insider purchases (*Only P*) in case all insider trades are purchases, and (*Mix*) if insiders both purchase and sell during the quarter. The figures are categorized according to the number of working days that pass between the earnings announcements and the occurrence of a insider transaction, 5-,10- days, 1-, 2-, and 3-months. The # of insider transactions are cumulated over the days after the earnings announcements when they occurred.

	Only S			Only P			Mix			Total
Days after EA0	# of trans.	%	% acum.	# of trans.	%	% acum.	# of trans.	%	% acum.	# of trans.
0 to 5 days	49,622	17.00%	17.00%	14,808	19.70%	19.70%	18,334	16.09%	16.09%	82,764
6 to 10 days	42,046	14.41%	31.41%	12,187	16.21%	35.90%	16,676	14.64%	30.73%	70,909
2 weeks to 1 month	78,917	27.04%	58.45%	21,014	27.95%	63.85%	31,311	27.49%	58.22%	131,242
2nd month	85,637	29.34%	87.80%	19,151	25.47%	89.33%	32,734	28.74%	86.96%	137,522
3th month	35,617	12.20%	100.00%	8,026	10.67%	100.00%	14,857	13.04%	100.00%	57,521
Total	291,838			75,187			113,911			479,957

Table 2.2: Descriptive statistics.

This table reports average characteristics for the firms in our sample categorized by quarter type. Panel A shows number of quarters, number of transactions and number of shares traded by insiders scaled by the number of shares outstanding. Panel B and C reports means for the main variables used throughout the chapter. All variables are defined in the Appendix. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

		All quarters	Only S	Only P	Mix	No IT
Panel A: Insider trading characteristics						
# of quarters		170,296	56,816	22,828	16,869	73,783
# of transactions		479,957	290,859	75,187	113,911	-
relative shares traded		0.61%	0.60%	0.45%	0.86%	0.00%
Panel B: Firm characteristics						
DISP		0.239	0.191	0.305	0.210	0.294
$\overline{OIBvol}_{(-14,-5)}$		22.92%	16.68%	29.26%	21.57%	26.41%
$\overline{OIBvol}_{(-4,+1)}$		21.81%	15.68%	28.09%	20.59%	25.20%
ΔOIBvol$_{(-14,-5)}$		0.19%	-0.38%	0.72%	-0.13%	0.56%
ΔOIBvol$_{(-4,+1)}$		-0.80%	-1.22%	-0.37%	-0.99%	-0.53%
INSOWN		51.28%	66.34%	42.84%	55.41%	40.90%
RSI		5.09%	6.30%	4.41%	5.55%	4.23%
Size		2,656	4,193	1,274	3,806	1,635
BtoMKT		0.648	0.502	0.808	0.597	0.732
ΔEPS		-0.27%	0.18%	-0.99%	-0.12%	-0.44%
Panel C: Returns						
Past abnormal ret. (1 year)		6.99%^{a}	17.22%^{a}	-6.29%^{a}	9.73%^{a}	2.60%^{a}
EA$_0$ abnormal ret.		-0.02%	1.11%^{a}	-1.46%^{a}	-0.11%^{c}	-0.44%^{a}
EA$_1$ abnormal ret.		-0.03%	-0.02%	0.14%^{b}	0.12%^{c}	-0.13%^{a}
Future abnormal returns	1m	-0.57%^{a}	-1.1%^{a}	0.55%^{a}	-0.29%^{a}	-0.57%^{a}
	2m	-0.78%^{a}	-1.96%^{a}	0.91%^{a}	-0.71%^{a}	-0.41%^{a}
	3m	-1.31%^{a}	-2.96%^{a}	0.86%^{a}	-1.56%^{a}	-0.64%^{a}
	6m	-2.95%^{a}	-6.09%^{a}	0.88%^{b}	-3.43%^{a}	-1.59%^{a}
	12m	-7.75%^{a}	-13.34%^{a}	-0.76%^{c}	-8.37%^{a}	-5.43%^{a}

Table 2.3: Panel regressions testing Miller (1977) model over the earnings announcements.

This table reports the association between divergence in investors' opinion, our proxies for short sale constraints and earnings announcements abnormal returns. The dependent variable is the abnormal return in the three days around the earnings announcements (EA_0 abnormal ret.). We control for the effect of firms' size (SIZE), book to market ratio (BtoMKT), earning surprises (ΔEPS) and past year returns (PastRET(1 year)) which are all defined in the Appendix. We estimate the model using pooled OLS and OLS controlling by firm and time fixed effects. We report robust standard errors in parenthesis. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

Variables	Pred. Sign	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DISP	(-)	-0.017^{a}	-0.015^{a}			-0.005	-0.004		
		(0.004)	(0.004)			(0.005)	(0.005)		
ΔOIBvol$_{(-14,-5)}$	(+)			0.068^{a}	0.069^{a}			0.044^{a}	0.044^{a}
				(0.003)	(0.003)			(0.004)	(0.004)
ΔOIBvol$_{(-4,+1)}$	(-)			-0.046^{a}	-0.043^{a}			-0.053^{a}	-0.050^{a}
				(0.003)	(0.003)			(0.003)	(0.003)
INSOWN	(+)	0.041^{a}		0.038^{a}		-0.035^{b}		-0.024^{c}	
		(0.005)		(0.004)		(0.015)		(0.013)	
RSI	(-)		-0.013^{a}		-0.014^{a}		-0.019^{a}		-0.019^{a}
			(0.003)		(0.003)		(0.005)		(0.005)
SIZE		-0.009^{b}	0.005	-0.002	0.030^{a}	-0.503^{a}	-0.532^{a}	-0.445^{a}	-0.414^{a}
		(0.004)	(0.004)	(0.004)	(0.003)	(0.028)	(0.026)	(0.023)	(0.020)
BtoMKT		0.006	0.002	0.020^{a}	0.016^{a}	-0.053^{a}	-0.058^{a}	-0.029^{a}	-0.031^{a}
		(0.005)	(0.005)	(0.004)	(0.004)	(0.011)	(0.011)	(0.008)	(0.008)
EPSch		0.030^{a}	0.028^{a}	0.033^{a}	0.029^{a}	0.028^{a}	0.026^{a}	0.033^{a}	0.028^{a}
		(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.004)	(0.004)
Past RET (1 year)		-0.006	-0.005	-0.006	-0.001	-0.007	-0.003	-0.011^{b}	-0.003
		(0.005)	(0.005)	(0.004)	(0.004)	(0.006)	(0.005)	(0.004)	(0.004)
Constant		0.011	0.009	0.028^{a}	0.003	0.165^{a}	0.165^{a}	-0.012	-0.009
		(0.013)	(0.014)	(0.011)	(0.012)	(0.015)	(0.016)	(0.012)	(0.012)
# Observations		82,527	87,684	117,856	130,342	82,527	87,684	117,856	130,342
R-squared		0.003	0.002	0.008	0.006	0.012	0.012	0.016	0.014
Firm FE		no	no	no	no	yes	yes	yes	yes
Year FE		no	no	no	no	yes	yes	yes	yes

Table 2.4: Calendar time portfolio analysis with order imbalance.

This table reports the intercepts (alphas) for trading strategies of zero-cost portfolios that hold stocks at the top quintile and sell short stocks at the bottom quintile of changes in order imbalance (ΔOIBvol). The portfolios are formed based on changes in order imbalance at 2 different time windows during the earnings announcements (-4,+1) and (0,+1). The alphas correspond to the abnormal return of a rolling strategy that goes long in the top quintile of ΔOIBvol (stocks less prone to be overpriced) and goes short in the bottom quintile of ΔOIBvol (stocks more prone to overpriced). To form the portfolios, each quarter we assign stocks into five portfolios according to ΔOIBvol quintiles and hold them in the portfolios for 1, 3, 6 or 12 months after EA_1. We calculate the portfolio return in a given month as the equally-weighted average of returns of all stocks in the portfolio. We include all available stocks with stock price greater than $5 at the time of portfolio formation. Monthly returns are winsorized at the 1st and 99th percentiles. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

	Four-factor alphas			
L/S strategies [quintile 5 - quintile 1]	1m	3m	6m	12m
$\Delta\text{OIBvol}_{(-4,+1)}$	0.011^a	0.011^a	0.011^a	0.010^a
	(6.874)	(8.009)	(8.644)	(8.921)
$\Delta\text{OIBvol}_{(0,+1)}$	0.002	0.004^a	0.006^a	0.006^a
	(1.360)	(3.783)	(5.533)	(6.503)

Table 2.5: Analysis of factors influencing the likelihood of insider trading.

This table reports estimation results for a multinomial logistic model. The dependent variable is a categorical variable that equals 0 for quarters without any insider trading (No IT), 1 for all quarters with insider sales only (Only S), 2 for all quarters with only insider purchases (Only P) and 3 for mix quarters (MIX). No IT quarters is the reference category and so this table reports 3 sets of estimated coefficients: for sale, purchase and mix quarters. The coefficients should be interpreted relatively to the reference category (No IT). We normalize the explanatory variables by subtracting the mean and dividing by the standard deviation. We report Hubert/White robust standard errors and allow them to cluster within firms. All variables are defined in the and are winsorized at the 1^{st} and 99^{th} percentiles. Year dummies are included in the regressions but are not reported. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

	Only S		Only P		Mix	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Panel A						
EA_0 abnormal ret.	0.257^{a}	(0.007)	-0.119^{a}	(0.008)	0.061^{a}	(0.010)
ΔEPS	0.031^{a}	(0.007)	-0.019^{b}	(0.008)	0.032^{a}	(0.009)
BtoMKT	-0.332^{a}	(0.021)	0.055^{a}	(0.016)	-0.096^{a}	(0.022)
PastRET(1 year)	0.152^{a}	(0.009)	-0.138^{a}	(0.013)	0.069^{a}	(0.013)
SIZE	0.732^{a}	(0.021)	-0.133^{a}	(0.023)	0.515^{a}	(0.026)
Constant	-0.055^{c}	(0.029)	-1.447^{a}	(0.041)	-1.221^{a}	(0.040)
# Observations	153,306					
χ^2	6294					
PseudoR^2	0.0762					
Panel B						
ΔOIBvol$_{(-4,+1)}$	-0.036^{a}	(0.009)	-0.002	(0.010)	-0.008	(0.012)
ΔOIBvol$_{(-14,-5)}$	0.003	(0.009)	-0.008	(0.010)	0.011	(0.013)
RSI	0.087^{a}	(0.020)	0.031	(0.021)	0.045^{b}	(0.023)
EA_0 abnormal ret.	0.267^{a}	(0.008)	-0.127^{a}	(0.009)	0.064^{a}	(0.010)
ΔEPS	0.033^{a}	(0.008)	-0.023^{a}	(0.009)	0.029^{a}	(0.010)
BtoMKT	-0.346^{a}	(0.023)	0.057^{a}	(0.017)	-0.087^{a}	(0.024)
PastRET(1 year)	0.160^{a}	(0.010)	-0.135^{a}	(0.015)	0.080^{a}	(0.014)
SIZE	0.710^{a}	(0.023)	-0.149^{a}	(0.025)	0.500^{a}	(0.029)
Constant	-0.048	(0.037)	-1.368^{a}	(0.053)	-1.186^{a}	(0.050)
# Observations	130,344					
χ^2	5798					
PseudoR^2	0.0773					

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	Only S		Only P		Mix	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Panel C						
ΔOIBvol$_{(-4,+1)}$	-0.044^a	(0.010)	-0.004	(0.010)	-0.010	(0.012)
ΔOIBvol$_{(-14,-5)}$	0.000	(0.010)	-0.003	(0.011)	0.015	(0.014)
INSOWN	0.598^a	(0.026)	0.016	(0.032)	0.175^a	(0.033)
EA$_0$ abnormal ret.	0.263^a	(0.008)	-0.127^a	(0.009)	0.064^a	(0.011)
ΔEPS	0.031^a	(0.008)	-0.022^b	(0.010)	0.024^b	(0.011)
BtoMKT	-0.327^a	(0.022)	0.040^b	(0.018)	-0.103^a	(0.024)
PastRET(1 year)	0.196^a	(0.011)	-0.146^a	(0.015)	0.092^a	(0.015)
SIZE	0.396^a	(0.028)	-0.145^a	(0.033)	0.382^a	(0.034)
Constant	0.120^a	(0.035)	-1.316^a	(0.048)	-1.051^a	(0.046)
# Observations	117,857					
χ^2	6332					
PseudoR^2	0.0902					

Table 2.6: Post-insider trading return analysis.

This table reports the intercepts (alphas) for trading strategies of zero-cost portfolios built on quintiles of changes in order imbalance (ΔOIBvol) and conditional on whether insiders sell or buy in a given quarter. In particular, the alphas evaluate the following strategy: (1) hold stocks with no insider trading in a given quarter and sells short stocks with only insider sales at different levels of changes in order imbalance, and (2) hold stocks with only insider purchases at different levels of changes in order imbalance and sell short stocks with no insider trading in each quarter. To form the portfolios, each quarter we assign stocks into five portfolios according to ΔOIBvol and conditioning on insider trading, and hold them in the portfolios for 1, 3, 6 or 12 months after EA_1. We calculate the portfolio return in a given month as the equally-weighted average of returns of all stocks in the portfolio. We include all available stocks with stock price greater than \$5 at the time of portfolio formation. Monthly returns are winsorized at the 1st and 99th percentiles. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

Strategies		No IT(all qrtrs) - Only S (per OIBvol quintile)					Only P (per OIBvol quintile) - No IT(all qrtrs)				
Portfolios based on	Horizon	Q1	Q2	Q3	Q4	Q5	Q1	Q2	Q3	Q4	Q5
ΔOIBvol$_{(-4,+1)}$	1m	0.008^a	0.008^a	0.006^a	0.006^a	0.004^c	0.003	0.001	0.003	-0.000	0.004
		(3.476)	(4.210)	(3.543)	(3.229)	(1.890)	(1.046)	(0.626)	(1.410)	(-0.074)	(1.441)
	3m	0.008^a	0.007^a	0.004^a	0.004^b	0.001	0.003	0.000	0.005^b	0.003	0.006^b
		(4.479)	(4.570)	(3.179)	(2.498)	(0.732)	(1.236)	(0.198)	(2.394)	(1.453)	(2.494)
	6m	0.007^a	0.006^a	0.005^a	0.003^c	-0.000	0.000	0.000	0.002	0.002	0.008^a
		(4.670)	(4.339)	(3.632)	(1.910)	(-0.270)	(0.196)	(0.111)	(1.432)	(1.396)	(3.731)
	12m	0.007^a	0.006^a	0.004^a	0.002^c	-0.001	0.001	-0.002	0.000	0.003^c	0.007^a
		(4.472)	(3.943)	(3.436)	(1.731)	(-0.665)	(0.476)	(-0.998)	(0.281)	(1.720)	(3.732)

Table 2.7: Analysis of factors associated with insiders' intensity for trading.

This table reports the association between our main explanatory variables and insiders' intensity after earnings announcements. The dependent variable in column 1 is $Relsharestr^{(Saleqrtr)}$, which is the relative number of shares sold by insiders in quarters with only insider sales and zero otherwise. The dependent variable in column 2 is $Relsharestr^{(Purchaseqrtr)}$, which is the relative number of shares bought by insiders in quarters with only insider purchases and zero otherwise. As both dependent variables take the form of a response variable, we estimate the specifications using Tobit regressions. We report robust standard errors in parenthesis. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

	Relsharestr	
	(1)	(2)
Variables	Sale qrtr	Purchase qrtr
ΔOIBvol$_{(-4,+1)}$	-0.304^{a}	0.091^{c}
	(0.078)	(0.049)
ΔOIBvol$_{(-14,-5)}$	0.130	0.006
	(0.084)	(0.053)
RSI	0.520^{a}	0.282^{a}
	(0.059)	(0.051)
EA$_0$ abnormal ret.	3.085^{a}	-1.329^{a}
	(0.071)	(0.051)
ΔEPS	0.011^{a}	-0.007^{a}
	(0.002)	(0.002)
BtoMKT	-0.559^{a}	0.114^{a}
	(0.014)	(0.008)
Past RET (1 year)	0.443^{a}	-0.192^{a}
	(0.010)	(0.009)
SIZE	0.156^{a}	-0.134^{a}
	(0.003)	(0.003)
Constant	-1.673^{a}	-0.425^{a}
	(0.026)	(0.018)
# Observations	130,344	130,344
Log Likelihood	-126,558	-51,720
χ^2	11,212	5,995
PseudoR^2	0.0424	0.0548

Table 2.8: Analysis of factors influencing the likelihood of insider trading: investor's attention.

This table reports estimation results for a multinomial logistic model including investors' attention as an additional factor. Investors' attention is measured as changes in daily turnover (ΔTO) in Panel A and as firms beating the analysts' forecast in the current quarter in Panel B. *Beat* is dummy variable indicating firms beating the analysts' forecast in the current quarter. The dependent variable is a categorical variable that equals 0 for quarters without any insider trading (*No IT*), 1 for all quarters with insider sales only (*Only S*), 2 for all quarters with only insider purchases (*Only P*) and 3 for mixed quarters (*Mix*). *No IT* quarters is the reference category and so we have 3 sets of estimated coefficients but we only report the ones we are more interested: purchase and sale quarters. The coefficients should be interpreted relatively to the reference category of *No IT* quarters. All variables are defined in Appendix. We winsorize the variables at the 1^{st} and 99^{th} percentiles and standardize them by subtracting the mean and dividing by the standard deviation. We report Hubert/White robust standard errors and allow them to cluster within firms. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels. Standard errors in the parenthesis.

	(1) Only S		(2) Only P		(3) Mix	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Panel A						
$\Delta TO_{(0,+1)}$	0.063^{a}	(0.010)	-0.017	(0.011)	-0.011	(0.014)
RSI	0.078^{a}	(0.020)	0.036^{c}	(0.021)	0.046^{b}	(0.023)
EA_0 abnormal ret	0.264^{a}	(0.007)	-0.131^{a}	(0.009)	0.063^{a}	(0.011)
ΔEPS	0.033^{a}	(0.008)	-0.024^{a}	(0.009)	0.029^{a}	(0.010)
BtoMKT	-0.342^{a}	(0.023)	0.057^{a}	(0.017)	-0.088^{a}	(0.024)
PastRET(1 year)	0.153^{a}	(0.010)	-0.132^{a}	(0.015)	0.081^{a}	(0.014)
SIZE	0.712^{a}	(0.023)	-0.147^{a}	(0.025)	0.499^{a}	(0.029)
Constant	-0.032	(0.037)	-1.371^{a}	(0.053)	-1.190^{a}	(0.049)
Observations	130,359					
χ^2	5885					
PseudoR^2	0.0776					
Panel B						
Beat	0.300^{a}	(0.021)	-0.153^{a}	(0.026)	0.058^{b}	(0.027)
RSI	0.045^{a}	(0.016)	0.011	(0.019)	0.015	(0.021)
EA_0 abnormal ret	0.236^{a}	(0.009)	-0.152^{a}	(0.012)	0.053^{a}	(0.012)
ΔEPS	0.024^{a}	(0.009)	-0.018	(0.011)	0.028^{b}	(0.012)
BtoMKT	-0.377^{a}	(0.026)	0.084^{a}	(0.020)	-0.095^{a}	(0.029)
PastRET(1 year)	0.182^{a}	(0.013)	-0.135^{a}	(0.020)	0.106^{a}	(0.017)
SIZE	0.623^{a}	(0.025)	-0.177^{a}	(0.031)	0.463^{a}	(0.035)
Constant	-0.035	(0.045)	-1.165^{a}	(0.067)	-1.059^{a}	(0.060)
Observations	97,662					
χ^2	5194					
PseudoR^2	0.0706					

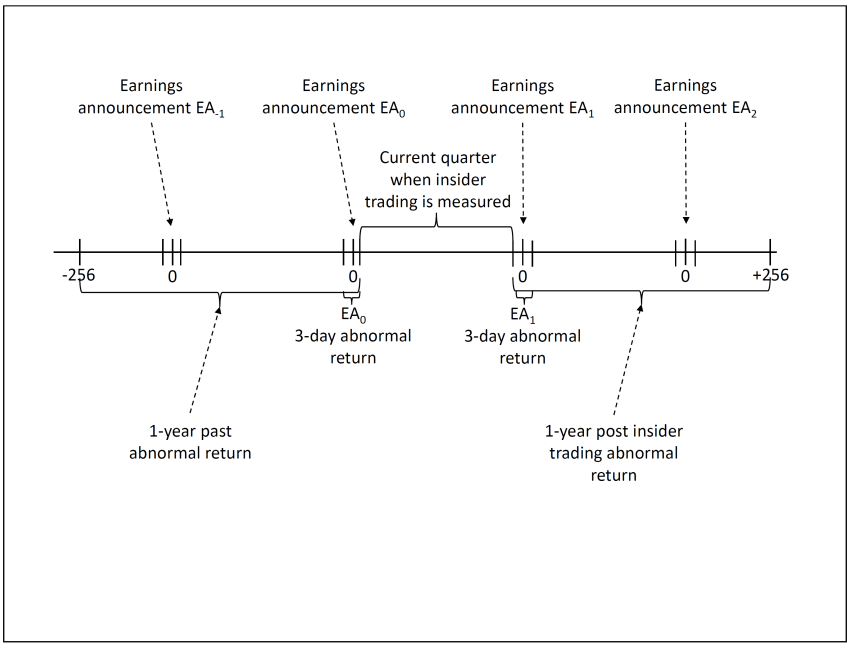
Table 2.9: Panel regressions on future fundamental information (return on assets and earnings per share).

This table reports fixed effects panel regressions of measures of future firm performance on insiders sales and divergence in investors' opinions. The dependent variables PostROA and PostEPS are the cumulative return on assets and earnings per share from the next quarter *(q+1)* until *(q+4)*. Similarly, ΔROA and ΔEPS are changes on return on assets, earnings per share and earnings announcements abnormal returns of the next quarter *(q+1)* relative to the current quarter *(q)*. *Only S* is a dummy variable equal to 1 in a firm-quarter with insider sales only. The remaining variables are defined in the Appendix. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

Variables	(1) PostROA	(2) PostEPS	(3) $\Delta ROA_{q+1/q}$	(4) $\Delta EPS_{q+1/q}$
Only S	0.084^{a}	0.141^{a}	0.023^{a}	0.029^{a}
	(0.005)	(0.007)	(0.006)	(0.006)
$\Delta OIBvol_{(-4,+1)}$	-0.018^{a}	-0.004	0.001	0.005
	(0.003)	(0.003)	(0.004)	(0.004)
$\Delta OIBvol_{(-4,+1)} \times$Only S	-0.008^{b}	0.004	0.010^{c}	-0.003
	(0.004)	(0.005)	(0.006)	(0.006)
$\Delta OIBvol_{(-14,-5)}$	-0.015^{a}	-0.004^{c}	-0.003	-0.002
	(0.002)	(0.003)	(0.003)	(0.003)
Constant	0.020^{b}	-0.046^{a}	0.009	0.009
	(0.010)	(0.012)	(0.009)	(0.009)
Observations	143,082	136,949	149,430	148,930
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

Figure 2.1: Timings of earnings announcements and related abnormal returns.

The figure shows the exact timings of earnings announcements and related abnormal returns relatively to the current quarter with insider transactions. The current quarter is defined as the period between 2 earnings announcements. Earnings announcement abnormal returns are always computed over 3 days around the earnings announcement date. 1, 3, 6 and 12-month returns start (end) 2 days after (before) the earnings announcement.



Chapter 3

Insiders versus short sellers: informed traders' competition around earnings announcements

Corporate insiders and short sellers are both considered to be informed traders in the literature. There is extensive evidence that both possess superior information as their trades are profitable.[1] However, little bearing exists on how the 2 informed traders interact in the financial markets and the implications of their interaction concerning information dissemination. The theoretical literature shows that when two or more informed investors compete for trading on the same information, this information is incorporated into stock prices faster. This is because informed traders then trade more aggressively to pre-empt the other traders from extracting their profits (Holden and Subrahmanyam, 1992;

[1] See for example Seyhun (1998) and Jeng et al. (2003) for a detailed review of the early evidence on the side of insiders, and Cohen et al. (2007) and Korczak et al. (2010) for a more recent one. For the side of short sellers see Diether et al. (2009) or Engelberg et al. (2012)

Shin, 1996; Back et al., 2000). Without competition, informed investors are motivated to trade slowly and in small quantities in order not to affect prices and maximize their profits (Kyle, 1985). In line with these arguments, Massa et al. (2015) show that facing short sellers' potential trading, insiders tend to accelerate their trading activities in order to pre-empt short sellers.

The primary aim of this chapter is to study the interaction between insiders and short sellers in the context of earnings announcements and to test whether their trading activities are affected by competition or not. We focus on the period around earnings announcements following recent stringent evidence that both insiders and short sellers are skillful information processors who can better interpret publicly available information (Kolasinski and Li, 2010; Engelberg et al., 2012; Alldredge and Cicero, 2015). Broadly speaking, this literature shows that a significant portion of insiders and short sellers superior trading advantage arises from trading on news events, such as earnings announcements. Earnings announcements are regular and frequent events that capture high attention from the media and allow investors to make their own interpretations about firms' value and, therefore, to generate their own private information (Kim and Verrecchia, 1994; Kandel and Pearson, 1995; Brown et al., 2009; Engelberg et al., 2012). The interaction between the 2 types of informed traders concerning a new public signal conveyed in earnings announcements provides a unique setup to study the nature of the competition and its consequences for stock price efficiency.

The main research question of this chapter then is whether insiders and short sellers compete for trading on superior information processing of publicly available information. On a sample of U.S. firms from July 2006 until December 2013, we show that in line with the superior information process-

ing hypothesis, both insiders and short sellers trades are concentrated right after rather than before earnings announcements. Furthermore, both types of informed traders trade intensively in the same stocks suggesting that they are competing for trading on their superior information processing. In fact, once insiders decide to sell after earnings news, they trade together with short sellers in about 83% of firm-quarters with insider sales in our sample. As a result of the competition, prices adjust faster in stocks in which they trade together relatively to stocks in which they trade alone.

Our analysis has four parts. First, we explore insiders' and short sellers' trading patterns around earnings announcements. We show that insiders and short sellers sell intensively 5 days after the earnings news. In fact, the average shares sold by insiders is around 45% higher in the first 5 days after the announcement date relative to the average shares sold in the subsequent 20 days. Likewise, the average short sales is about 12% higher at the same period. Interestingly, short sellers seem to anticipate insiders' information processing. While short sellers' peak of trading is concentrated at the earnings announcement date, insiders' sales peak at the 3rd day after the news release. The peak in insider sales at day +3, however, is consistent with blackout periods during which insiders are not allowed to trade (Bettis et al., 2000; Cohen et al., 2012). Although we are not able to directly test for the presence of these blackout windows, our results strongly suggest that the blackout periods are the primary reason for insider trading delays after earnings announcements.

Second, we test whether insiders' and short sellers' intensive trading after the earnings news is consistent with competition for trading on the same public signal. Massa et al. (2015) show that higher past short selling potential is positively associated with higher frequency and intensity of insider sales in a

given month, implying that the 2 types of informed traders compete for trading on the same private information. In line with Massa et al. (2015), we show that higher short selling potential before earnings announcements increases significantly the odds of insiders' and short sellers' trading intensively in the same stocks after the earnings announcement date. Moreover, short selling potential decreases the likelihood of insiders selling intensively while short sellers trade with low intensity. This suggests that insiders are less likely to compete when they do not perceive short sellers' threat.

Third, we explore stock return predictability. We show that both insider sales and short sales after earnings announcements are associated with lower future returns, and this is irrespective of whether insiders and short sellers trade in the same stocks or not. However, in line with the 2 types of informed traders competing with each other, stock returns are more negative faster in stocks with intensive trading by both types together relative to cases in which one type trade intensively and the other doesn't. Also, returns are lower faster in stocks with intensive trading by both insider and short sellers regardless of the direction of the earnings news, but price adjustment is concentrated in stocks with positive and negative news. This suggests further that both informed traders seem to be trading in stocks in which the market has overreacted to positive news and underreacted to negative news.

Finally, we check whether instead of competition, the large stock price correction we observe for firms in which insiders and short sellers trade intensively together is concentrated in stocks that exhibit larger mispricing during the earnings news. Insiders and short sellers could be selling stocks for which the market felt too enthusiastic about and, as a result, these stocks experience high buying pressure that pushes prices up causing large overpricing. Hence,

we test whether low post earnings returns in firms with intensive trading by both insider and short sellers are concentrated in stocks that exhibit higher buying pressure right after the news. We find that irrespective of the level of buying pressure, stocks with high intensity of both types of informed traders together show lower future abnormal returns. Further, we also run the same test using dispersion in analysts' forecasts as an alternative measure that captures different levels of overpricing.[2] In line with our findings, even for different levels of dispersion in analysts' forecats, price adjustment is faster in stocks in which insiders and short sellers compete for trading.

Our results are important as we document that part of the trading advantage of insiders and short sellers comes due to their superior information processing skills. We show that both types of informed traders use their skills to process public news better and trade profitably. This is line with recent evidence studying short sales or insider trades separetely.[3] We extend this literature by showing that very frequently both types of informed investors compete for trading on the same information. More importantly, as a result of the competition both traders tend to accelerate their trading decisions and trade faster making stock prices more efficient.

We are not the first analyzing the trading decisions of insiders and short sellers together, but we are the first to do so in the context of public news announcements. Massa et al. (2015) are the closest to our analysis, but they focus on trading decisions by insiders who possess material information that

[2]Miller (1977) shows that stocks are more overpriced when investors' opinions about firm's value diverge more, provided that short sales constraints are biding. In line with Miller (1977), Diether et al. (2002) use dispersion in analysts' forecasts as a measure of investors' disagreement and show that stocks with higher dispersion in analysts' forecasts earn lower future returns.

[3]See Engelberg et al. (2012) for the side of short sellers, and Kolasinski and Li (2010) and Alldredge and Cicero (2015) for the side of insiders.

is not yet disclosed to the market. In a theoretical and empirical analysis, they show that facing higher short selling potential, insiders trade more shares (as a fraction of their stakes) and more frequently. However, even when short selling potential may reasonable indicates that short sellers are more likely to trade afterwards, it does not represent a direct proof that indeed this is the case. We go one step further in our empirical analysis and show more directly that insiders and short sellers trade very frequently and intensively when short selling potential is high.

Moreover, Massa et al. (2015) model assumes that insiders and short sellers always possess the same private information. As a result, competition is triggered simply by the presence of short sellers (or higher likelihood of their presence) that fully threatenes insiders' profitable trades.[4] Thus, Massa et al. (2015) fail to take into account situations where insiders' and short sellers' possess different signals (or uncorrelated signals), as in Back et al. (2000) model. Our setup allows us to perform more detailed analysis of the interaction between a public signal and insiders' and short sellers' trading decisions. We are able to show that, in line with Back et al. (2000), when insiders and short sellers disagree on their information processing, stocks prices adjust slower than in cases where they share the same information.

Chakrabarty and Shkilko (2013) study short selling activity surrounding insider trades to explore the source of short sellers trading advantage. They find that short selling done by non market makers increases by 26% on insider selling days. Also, the increase in short selling occurs on the days when insiders trade and not when their trades are announced suggesting that short sellers could be trading on private information. Chakrabarty and Shkilko (2013)

[4]Holden and Subrahmanyam (1992) make the same assumption.

show that short sellers' trading in anticipation of insider sales is consistent with both trading on private information and their ability to better analyze publicly available information. Our main objective is different as we seek to determine whether the 2 types of informed traders have better skills analyzing public news (or better information processing) and whether their trading decisions are affected by competition. However, in line with their results we show that short sellers seem to anticipate insiders when trading after earning announcements, but we attribute this pattern to blackout periods that some firms establish to their insiders. More importantly, we are able to extend their findings by showing that not only short sellers but also insiders trade on superior information processing.

We contribute to the insider trading literature in two important ways. First, we contribute to the discussion on whether insider trades are motivated by foreknowledge of future material information (Ke et al., 2003; Cheng et al., 2007) or by their ability to recognize when their stocks are mispriced (Piotroski and Roulstone, 2005; Jenter, 2005). Our results are difficult to reconcile with the first view. This is due to our setup is designed to analyze trading decisions of both informed traders around earnings announcements. We show that both insiders' and short sellers' trades are concentrated on the news days or later and, therefore, their trades are more likey to be associated with information obtained due to their superior information processing skills rather than foreknowledge of future material information. Also, the fact that insiders trade together with short sellers provides a strong argument that insider trades are associated to the earnings news, as short sellers usually follow short-term trading strategies.[5]

[5]Diether et al. (2009) argue that short sellers cover their positions very rapidly. Diether

Second, the empirical literature finds little evidence that insider sales are profitable (Jeng et al., 2003; Jenter, 2005). The main argument for these findings is that insiders could trade for reasons other than foreknowledge of material information, such as liquidity or diversification (Lakonishok and Lee, 2001; Cheng et al., 2007; Cohen et al., 2012). The evidence by Cohen et al. (2012) is a notable exception. They show that performing simple screening to insider trading frequencies, both insider purchases and sales are profitable. Cohen et al. (2012) conclude that their findings support the view that some insider trades are driven by foreknowledge of future material information. Another exception is Alldredge and Cicero (2015) who study insider trading when firms disclose having concentrated business relationships with other companies. They show that insiders sell profitably based on public information about their main customers. Alldredge and Cicero (2015) argue that their results are suggestive that insiders are attentive to the information released at public news announcements. Our results support the evidence of Alldredge and Cicero (2015). More importantly, we are able to extend the literature by showing that insiders sales that are affected by competition with short sellers after earnings announcements show strong return predictability.

We also contribute to the literature about competition between informed traders. Our results are in line with the theoretical predictions of Holden and Subrahmanyam (1992) and Massa et al. (2015), but more closely related to Back et al. (2000). Back et al. (2000) show that when 2 or more informed investors have correlated private information (or signal), they tend to trade more aggressively in order to pre-empt the other informed traders from ex-

(2008) finds that 50% of the lending contracts in their sample are closed out in 11 trading days.

tracting their benefits. Thus, stock prices adjust faster to their trades making them more efficient. In line with their predictions, we show that when insiders and short sellers trade together after earnings announcements prices adjust faster than in stocks where they trade alone.

The remainder of the chapter proceed as follows. Section 3.1 provides a brief background and discusses our main testable implications. Section 3.2 describes the databases we use and provides summary statistics. Section 3.3 shows our main analysis and findings. Section 3.4 concludes.

3.1 Background and testable implications

An informed trader in Kyle (1985) model trades in such a way that his private information is incorporated into stock prices gradually. This is because market makers cannot distinguish trades made by an informed investor from trades made by noisy traders. Consequently, an informed investor maximize her profits when there are more noisy traders in the market providing the informed trader with the perfect camouflage for her profitable trades.

The situation changes in the presence of 2 or more informed investors. Holden and Subrahmanyam (1992) study how market depth and efficiency changes when varying the number of informed traders in the market. They develop a multiperiod auction model with multiple informed traders and find a unique linear equilibrium in which informed traders trade aggressively. Even with only 2 informed traders nearly all the common private information is incorporated into stock prices almost immediately. In line with Holden and Subrahmanyam (1992), Massa et al. (2015) predict that insiders and short sellers compete for trading on private information. In particular, Massa et al.

(2015) show that insiders in possession of negative material information are motivated to sell faster and intensively when facing potential short selling.

Nevertheless, Holden and Subrahmanyam (1992) and Massa et al. (2015) assume that all informed traders have the same private information (or perfectly correlated signal) and, therefore, ignore cases in where their opinion about firms' value diverge (uncorrelated signal). In a step forward, Back et al. (2000) show that Holden and Subrahmanyam (1992) equilibrium holds only in cases when traders have correlated signals, otherwise aggregate trading is less intense and the information is revealed slowly. Therefore, whether competition among informed traders leads to more intensive trading and quicker private information revelation depends crucially on how correlated are the signals distributed between the informed investors.

The main research question of this chapter is whether insiders and short sellers compete for trading on superior information processing of the news released in earnings announcements. Although all the models described above are framed around trading decisions based on foreknowledge of future material information, the predictions are equally valid in the context of processing public information. We argue that the main driver of competition between informed traders at the earnings announcements comes for their ability to better analyze the fundamental information contained in the news. In particular, when stock prices deviate away from firms' fundamental values, both insiders and short sellers are motivated to trade. However, a monopolistic informed trader has an incentive to spread her trading in order not to alter prices and maximize her profits (Kyle, 1985). This is especially true in the context of earnings announcements when investors' attention is high providing the informed trader with the perfect camouflage for her trades (Brown et al.,

2009).[6] Therefore, in the absence of short sellers (insiders), insiders (short sellers) have all incentives to delay their trading as they could make profitable trades.

Massa et al. (2015) use the supply of shares available for lending as a measure that captures short selling potential. Although a higher supply of shares available for lending is an indication that short sellers are likely to trade, the link is somewhat loose. Hence, Massa et al. (2015) are not able to observe whether insiders and short sellers are indeed trading at the same time over the same information. Our setup permits to overcome these difficulties as we are able to clearly distinguish different trading decisions of insiders and short sellers during earnings announcements. Namely, we are able to identify cases where both types trade intensively together in the same stocks, cases with intensive insider selling and low or no short selling, cases with intensive short selling and low or no insider selling and cases when there is little or no insider or short selling activity.

We take cases in which insiders and short sellers trade intensively in the same stocks at the same time as a more direct indication of competition. Also, we consider cases with insider selling (short selling) and low or no short selling (insider selling) as indicative of a more monopolistic behaviour. If this is the case, in line with Massa et al. (2015), there should be a positive association between short selling potential before the news and competition between insiders and short sellers after the announcement date. In particular, we con-

[6]According to Brown et al. (2009), earnings announcements generally captures high attention from uninformed investors. This is due to pervasive discussion of firm's earnings news in the financial media (Barber and Odean, 2008; Brown et al., 2009). Therefore, uniformed investors are likely to trade intensively at the earnings announcements, as they generally trade in stocks that garner their attention (Barber and Odean, 2008; Frieder and Subrahmanyam, 2005; Grullon et al., 2004).

jecture that insiders and short sellers are more likely to trade intensively in the same stocks shortly after earnings announcements when the supply of lending shares is higher before the announcement date. In contrast, low short selling potential should be associated with a more monopolistic behavior of insiders. Therefore, we predict a negative a association between short selling potential trading and insider selling intensively without short sellers. Our first testable implication is as follows:

Insider and short sellers are more likely to trade intensively in the same stocks after earnings announcements when the supply of lendable shares is higher before the news release. Also, insiders are more likely to trade without short sellers in firms with a low supply of lendable shares before the news release.

We next turn to profitability of insiders' and short sellers' trades and its implications for information dissemination. The literature is split concerning whether news events, such as earnings announcements, could represent profitable trading opportunities for informed investors. On the one hand, the publication of earnings are associated with a reduction in information asymmetry diminishing the chances of profitable trades by informed investors (Diamond and Verrecchia, 1987; Korajczyk et al., 1991; Berkman et al., 2009). On the other hand, quarterly earnings announcements allow investors to make their own judgements about firm value and, therefore, to generate their own private information (Kim and Verrecchia, 1994; Brown et al., 2009; Engelberg et al., 2012). As investors disagree about interpretation of the public news, information asymmetry increases presenting profitable trading opportunities for informed investors.

In line with the second view, we argue that both insiders and short sellers recognize when stocks become mispriced during earnings announcements. Thus, we predict significantly lower future abnormal returns for stocks where these 2 types informed traders sell intensively. However, competition adds an extra ingredient to the analysis. We expect that in firms where insiders and short sellers trade intensively together after the news release, post earnings announcements abnormal returns are more negative faster relative to firms where only short sellers or insiders trade alone. The second testable implication is as follows:

Post earnings announcements abnormal returns are lower for firms with insider sales and/or short sales. However, post earnings announcements abnormal returns are lower faster for firms where insiders and short sellers sell intensively together after earnings announcements than in firms where only short sellers or only insiders sell.

3.2 Data

We obtain data from several sources. Insider trading data is from Thomsom Financial Insider Filings which contains all insider activity as reported in the forms 3, 4 and 5 specified by the Security Exchange Act of 1934. It covers detailed information about the transactions and the insiders including the trading date, announcement date, insiders name and role in the firm, number of shares traded, transaction price and transaction type (purchase or sale). Data on equity lending loans and supply is from Markit (who acquired Data

Explorers), which collects this information daily from 125 large custodians and 32 prime brokers in the securities lending industry. The data cover more than 85% of the securities lending market. A more detailed description of the data can be found in Saffi and Sigurdsson (2010). We also obtain financial statement data from COMPUSTAT, stock returns from CRSP, analysts' forecasts from I/B/E/S and high frequency data from NYSE Trades and Quotes database (TAQ).

Altogether, our sample comprises security-level daily information from July, 2006 to December, 2013. Because, our analysis is built around earnings announcements, we aggregate all insider trading and short selling activity around quarterly earnings announcements.[7] We obtain quarterly earnings announcements from the COMPUSTAT quarterly data file and delete firm-quarters for which no COMPUSTAT data are available. For each earnings announcement, we define three time periods: (i) the earnings announcement period: the period beginning on working day -1 and ending on day +1, (ii) the informed trader response period: the period beginning on working day 0 and ending either after day +5 or day +20. (iii) the future return period, which is closely linked to the informed trader response period ending, and finishes after 6 months. Consequently, the period runs over day +5 up to day +130 or alternatively over +20 until +145. Figure 3.1 describes the setup graphically.

Insert Figure 3.1 about here.

We base our analysis on 2 measures. The relative number of shares sold by insiders (*INsales*) and the daily number of stocks on loan (*Onloan*), both

[7] As there could be more than one insider transaction per day, before aggregating the data we merge all insider transactions within one day of the same director in the same direction (purchases/sales), but we keep transactions if in different direction even on the same day.

scaled by the number of shares outstanding. For the *Onloan* measure, we take shorting transactions with a start date at the most recent business day.[8]

An important feature of our dataset is that it allows to distinguish different trading decisions of insiders and short sellers after earnings announcements. Namely, we are able to identify cases where both types trade intensively together in the same stocks, cases with intensive insider selling and low or no short selling, cases with intensive short selling and low or no insider selling and cases when there is little or no insider or short selling activity. This identification is very relevant to our purposes as we consider firms where both insider and short sellers trade intensively together as a strong indication of competition, but also because in cases where neither of them trade or trade in small quantities constitute very important benchmark categories. Hence, we classify each firm-quarter in our sample as one the following types:

- *Onloan&INsales* is a firm-quarter with both intensive short selling and intensive insider selling activity during the informed trading response period (see Figure 3.1). Namely, it is a firm-quarter with short selling activity in the top 2 terciles and insider selling activity above the median of the number of shares traded by both types after an earning announcement.

- *Only Onloan* is a firm-quarter with intensive short selling and little or no insider selling during the informed trading response period. In particular, is a firm-quarter with short selling activity in the 2 top terciles of the number of shares shorted and with insider selling activity below

[8]Markit has data also on the daily number of stocks that are on loan at different start dates, such as at 3, 7 and 30 days. We believe *new* stocks on loan is a better fit to our purposes as we want to analyze short sales that are more likely to be attributed to the earnings announcements.

the median of the number of shares sold by insiders after earnings announcements.

- *Only INsales* is a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period. More specifically, it is a firm-quarter with insider selling activity above the median of the number of shares sold by insider and with short selling activity in the bottom tercile of the number of shares shorted after an earning announcement.

- *Low informed trading* is a firm-quarter with low or no insider and short selling activity during the informed trading response period. Namely, it is a firm-quarter with insider selling activity below the median of the number of shares sold by insiders and with short selling activity in the bottom tercile of the number of shares shorted after earnings announcements.

We define cut-off points at the median for insider sales and terciles for short sales because selling activity by insiders is much less frequent and intense than short sales. Although the cutoff points may look arbitrary, we believe is a reasonable approximation to capture different levels of trading intensity after earnings announcements. Table 3.1 describes our sample of firm-quarters and the number of shares traded by insiders and short sellers in each category. In Panel A, we categorize each firm-quarter with the trading activity during the whole trading response period (0,+20) and in Panel B during the 6 days immediately after the announcement date (0,+5).

In total we have 102,149 firm-quarters. In 28.5% of all firm-quarters insiders and short sellers coincide in their intensive trading. In Panel A, while firm-

quarters with intensive short selling only are the most frequent (around 40% of the firm-quarters in our sample), firm-quarters with intensive insider sales only are the least frequent (around 6% of the quarters). Quite striking is the fact that conditional on insiders trading, insiders sell in the same stocks with short sellers in about 83% of the firm-quarters in our sample. Firm-quarters with low intensity of both insider and short sales are relatively high in frequency, representing 25% of the sample. This distribution changes a little in Panel B, where the categories are defined based on trading activity until day +5. While the firm-quarters with *Onloan&INsales* are less frequent compared to Panel A, firm-quarters with *Only Onloan* are higher. These differences comes from the exchange between these two categories in Panels A and B. That is, for example, firm-quarters classified as *Only Onloan* in Panel B (when considering trading activity until day +5), move to *Onloan&INsales* in Panel A (when considering trading activity until day +20) because insiders continue selling after day +5 of the announcement date.

Looking at the intensity of trading, we see that insiders and short sellers trade more intensively together (*Onloan&INsales*) than in cases when they trade separated. In Panel A, trading together short sellers sell around 0.22% of the company stocks and insiders 0.007%, while when trading separately these figures are 0.17% and 0.006%, respectively. These differences are stronger in Panel B, especially for insiders who sell around 0.009% of their company stocks when short sellers are also selling.

Insert Table 3.1 about here.

Other variables we use throughout the analysis are the number of shares available for lending scaled by the shares outstanding (*Lendable*) and the pos-

itive component of daily order imbalance ($Oimb^{+}$). The first measures short selling potential (Massa et al., 2015) and the second captures firms' buying pressure (Diether et al., 2009). Buy order imbalance is computed as the daily buys minus sells scaled by the daily volume.[9] We also use abnormal returns during and after a quarterly earnings announcements. Abnormal returns are calculated as the difference between the buy and hold raw return and its corresponding 5x5 size and book to market portfolio return over a certain period of time $BHAR_{i,t} = [\Pi_{t=t_1}^{t_2}(1 + R_{i,t}) - 1] - [\Pi_{t=t_1}^{t_2}(1 + E(R_{i,t})) - 1]$, where $R_{i,t}$ is the realized return on day t. Other standard variables we use are firm size, book to market, earnings per share and dispersion in analysts' forecast, which are all defined in the Appendix.

In Table 3.2 we summarize the characteristics of our sample. Panel A provides summary statistics for all firms and Panel B summarizes differences across our categorical variable for informed trading. Panel A shows that the average firm in our sample has a market capitalization of 2.97 billion USD, a book-to-market ratio of 0.69 and a negative change in earnings per share of -0.37%. Also, the firms in our sample have on average 18% of its total shares outstanding in the inventory available for borrowing *(Lendable)*, but with a high standard deviation (12%) which indicates an active equity lending market in the US and a significant variation among firms across the years (These numbers are very similar to what Massa et al. (2015) reported). Moreover, the average firm in our data has 0.002% of its shares outstanding sold by insiders and 0.15% shorted by short sellers.

[9]Buy and sells orders are defined using Lee and Ready (1991)

Insert Table 3.2 about here.

Panel B shows differences in firm's characteristics across the informed trading categories. Stocks where insiders and short sellers trade intensively together (*Onloan&INsales*) are on average larger in size (4.8 billion USD), more profitable (B/M ratio of 0.46), and have a larger fraction of its total shares outstanding available for borrowing (26.3%) than stocks in the other 3 categories. Stocks with only insider sales (*Only INsales*) share similar characteristics to stocks with *Onloan&INsales*. In particular, *Only INsales* stocks are large on average (4.4 billion USD) and have lower B/M ratio (0.64) relative to stocks with only short sales or stocks with low informed trading. Note that the average *Lendable* for these stocks is the lowest relative to the other categories (15%). In contrast, stocks where short sellers trade alone are smaller (2.9 billion USD) and less profitable on average relative to *Onloan&INsales* (B/M ratio of 0.65).

3.3 Results

3.3.1 Informed trading patterns around earnings announcements

In this section we provide an overview on how insider and short selling trades are distributed around the earnings announcements. Figure 3.2 plots the relative number of shares sold by insiders (*INsales*) and the relative number of stocks on loan (*Onloan*) in the days surrounding the announcement date. As the size of insider sales is considerably smaller relative to the size of short sales, we place the range of *Onloan* values in the left axis and of *INsales* on

the right axis to make trading patterns comparable. We see that the earnings announcement date significantly affects insiders' and short sellers' trading patterns. In line with Engelberg et al. (2012), short sales increase slightly before the announcement date, but rise sharply at day 0 and stay relatively high for a few days. Insider sales, in contrast, show a minor increase on day 0, peak significantly at day +3 and then remains high for several days. Surprisingly, short sellers seem to be faster in timing their sales relatively to insiders. However, the peak in insider sales at day +3 is likely associated with blackout windows, which are firm specific explicit periods when insiders are not allowed to trade (Bettis et al., 2000; Cohen et al., 2012).

Insert Figure 3.2 about here.

In Figure 3.3 we partition all earnings announcements into GOOD, BAD and NO news according the earnings announcements abnormal returns. Hence, firms with GOOD, BAD and NO news are firms with a 3-day earnings announcements abnormal return (window (-1,+1)) in the top, lowest and middle tercile of the returns for all the quarters respectively. Figure 3.3 shows that short sellers increase their trading activity at the announcement date for both GOOD and BAD news stocks. Insiders, in contrast, are much more active sellers after GOOD news relative to BAD news confirming the well known contrarian pattern of insider sales (Sivakumar and Waymire, 1994). Importantly, short sellers seem to trade before insiders regardless of the direction of the news and the peak for insider sales remains at day +3. This evidence gives more support to the idea that the anticipation of short sellers is driven by the presence of blackout periods.

Insert Figure 3.3 about here.

Finally, Figure 3.4 partitions the sample by the informed trading categories: based on trading activity until day +20 in Panel A and until day +5 in Panel B. As in the figures above, short selling activity peaks at day 0 when short sellers trade alone (*Only Onloan*) or together with insiders (*Onloan&INsales*). Still, short sellers trade a little more intensively when insiders are selling intensively at the same time. Similarly, when insiders are selling their sales peak at day +3 regardless of short sellers trading. The decreasing pattern for insider sales is a little more gradual when they trade alone (*Only INsales*) than when trading together with short sellers (*Onloan&INsales*), suggesting that insiders tend to spread their trades when they do not face competition. Furthermore, the fact that insider sales peak at day +3 also when trading together with short sellers and regardless of the direction of the news suggests the presence of blackout periods for insiders. This is because even in cases when they have every reason to trade sooner as they face competition with short sellers, they only start trading on day +3 (on average). This pattern strongly suggest the existence of imposed trading constraints.

In Panel B the categories are based on trading activity until day +5. The patterns just described for insider sales and short sales in Panel A remain very similar to Panel B. However, we observe subtle differences in insider sales patterns. In Panel B, the intensity of trading by insiders in the days following the news is stronger than in Panel A. In particular, while in Panel A the relative number of shares sold by insiders in firms with short sales peak to a little more than 0.01% at day +3, in Panel B this figure is about 0.03%. This is natural as in Panel A the categories are based on trading intensity until day

+20, so the lower peak reflects that insider sales continue occurring frequently after day +5, but much less intensively pushing the average intensity until day +5 down. Therefore, the informed trading category based on trading intensity until day +5 depicts a more clear picture about what happens in the first days after the announcement date.

Insert Figure 3.4 about here.

Clearly, Figures 3.2 to 3.4 show that short sellers trade before insiders do on average, suggesting that short sellers are faster information processors than insiders. This is quite counterintuitive. Insiders have access to better information easily than outsiders do about the prospects of their firms, and therefore is quite natural to assume that insiders are faster. In fact, one important assumption in Massa et al. (2015) model is that insiders are more informed than short sellers and therefore insiders trade faster in the presence of short sellers. The fact that insiders seem to be following short sellers is surprising even for us, but we strongly believe that this anticipation pattern is driven by the ban periods referred above. Although we are not able to test this formally, the graphs provide a suggestive evidence in support of the ban periods.[10]

Furthermore, our results are in line with the evidence by Bettis et al. (2000). They survey 1,915 firms members of the American Society of Corporate Secretaries regarding corporate policies and restrictions on insider trading. They find that 78% of the firms on their sample had explicit blackout periods, and the most common policy established by these firms was disallowing trading by insiders at all times except during a trading window that is open during the period 3 through 12 trading days after the quarterly earnings announcement.

[10]Ideally we would have information about firms' policies regarding insider trading, but these policies are firm specific and this information is not publicly available.

3.3.2 Competition for trading.

Section 3.3.1 shows that both insiders and short sellers trade after earnings announcements the same company's stocks in around 29% of our sample. Also, both insiders and short sellers tend to trade together intensively shortly after the announcement date. Although, this is an indication that both may be competing to trade over the same firms' stocks, this section is oriented to test this evidence more formally.

The first test we perform follows a similar approach as Massa et al. (2015). In particular, we analyze whether short selling potential trading before earnings announcements predicts insider and short selling activity after the news release. As in Massa et al. (2015), we use the supply of shares available for lending (*Lendable*) as a measure that captures short selling potential. We conjecture that insiders and short sellers are more likely to trade aggressively over the same company's stocks when *Lendable* is higher before the announcement date. In contrast, high *Lendable*, so higher short selling potential, should have a negative or at least insignificant effect over insiders' likelihood to trade alone. This is because in the absence of short sellers insiders are more willing to delay trading (Kyle, 1985).

As we want to determine whether *Lendable* predicts insider and short selling activity after an earnings announcements, we use our categorization of informed trading as the dependent variable. Recall that this variable has 4 possible outcomes, which are: (i) *Onloan&INsales*, (ii) *Only Onloan*, (iii) *Only INsales* and (iv) *Low informed trading*. Consequently, we run a multinomial logistic regression as it fits our set-up best. The dependent variable is a categorical variable including the referred outcomes based on trading intensity 5

days after an earnings announcement.[11] We take *Low informed trading* as the reference category and, therefore, report three sets of regression coefficients. They have to be interpreted relatively to the *Low informed trading* category. In all specifications, we also include year dummies, but we do not report them to save space. We compute robust standard errors and allow them to cluster within firms. In order to determine importance of the individual explanatory variables for each outcome, we standardize the explanatory variables by subtracting their mean and scaling by their standard deviation. The standardization means that the units of the regression coefficients are now the same and therefore are directly comparable across variables. The results are reported in Table 3.3.

Insert Table 3.3 about here.

In line with Massa et al. (2015), insiders and short sellers are more likely to trade intensively in the same stocks for firms with higher short selling potential (*Lendable*) relative to firms with low intensity of insider or short sale transactions (*Low informed trading*). Unsurprisingly, *Lendable* also increases the odds of short selling trading intensively alone (*Only Onloan*), reflecting that short sellers trade in firms with lower shorting constraints. Finally, even when *Lendable* increases significantly the relative probability of insider selling intensively alone (*Only INsales*), this probability is significantly lower compared to the other outcomes.[12]

[11] We also run the same specification with the dependent variable based on trading intensity until 20 days after an earnings announcement, but we don't report it to save space. The results remain unchanged.

[12] A wald-test for the difference between the coefficients equals to zero strongly rejects the null at 1% level.

As the coefficients in a multinomial logistic regression are relative to the base category, they are a little difficult to interpret. Therefore, we also compute the marginal effect that our independent variables have over each outcome separately. This not only allows to have the unconditional probability of *Lendable* over each category, but also it gives a better approximation to compare the magnitudes of the probabilities across the outcomes. The results are reported at the bottom in Table 3.3. We confirm, for example, that *Lendable* increases the odds of insiders and short sellers trading together (*Onloan&INsales*) and this probability is significantly higher than for the other 2 outcomes. More importantly, note that the average marginal effect of *Lendable* is significantly negative for firms with only insider sales (*Only INsales*). This indicates, in line with our predictions, that low short selling potential is associated with a more monopolistic behavior of insiders. In particular, 1 standard deviation increase in the relative number of *Lendable* shares is associated with a 2.3% reduction in the probability of insiders selling alone after the earnings news.

Looking a the remaining control variables we also see interesting results. First, while insiders and short sellers are more likely to trade together in stocks with more positive news than with more negative news, the opposite goes for short sellers trading alone. In particular, while the relative probability of *GOOD news* firms is significantly higher than *BAD news* over the *Onloan&INsales* outcome, the reverse holds for the *Only Onloan* category. The marginal effects confirm these results. While the marginal effect of positive news firms significantly increases the likelihood of *Onloan&INsales*, it significantly reduces the probability of *Only Onloan*. In contrast, the marginal effect of negative news significantly reduces the odds of *Onloan&INsales* and increases the probability of *Only Onloan*.

The results also suggests that when insiders and short sellers trade together, they trade on average as contrarians as opposed to cases where only short sellers trade. The 6-month past return increases the odds of both types trading together (*Onloan&INsales*) and decreases the odds of short sellers trading alone (*Only ITsales*). Also, in line with the contrarian behavior, the negative coefficient for book to market ratio indicates that insiders and short sellers are more likely to sell high valuation stocks (Jenter, 2005), and this probability is higher than for short sellers trading alone (*Only Onloan*). This result is reinforced by the marginal effects. The average marginal effect of book to market is positive in firms *Only Onloan*, suggesting that short sellers are likely to trade alone in low valuation stocks. Firms with only insider sales tend to mimic the pattern of firms with both insider and short sale transactions. This is no surprising as the literature documents insiders contrarian behavior when trading (Sivakumar and Waymire, 1994; Rozeff and Zaman, 1998; Piotroski and Roulstone, 2005; Jenter, 2005).

3.3.3 Predictability of post earnings announcements returns.

In this section we explore the second testable implication of the chapter which has two branches. Our first aim is to analyze whether insiders and short sellers are informed traders who can make profitable trades at the earnings announcements. Our second aim is to show that, consistent with insiders and short sellers trading for competition, post earnings returns adjust faster in firms where both trade intensively together than in firms where each of them trade alone.

To test these conjectures we run panel regressions of post-earnings announcements buy and hold abnormal returns *(PostBHAR)* on our categorical variable of informed trading. Returns are adjusted for the corresponding 5x5 size and book to market portfolio return and are compounded over different time horizons after earnings announcements (see Figure 3.1). The results are reported in Table 3.4. Panel A includes specifications for all the firms-quarters considering post earnings announcement returns beginning at day +20 (subsequent return period 1 in Figure 3.1) and Panel B displays post earnings returns starting at day +5 (subsequent return period 2 in Figure 3.1). We include *Lendable* as a control variable in all the specifications.

Insert Table 3.4 about here.

Consistent with our predictions, Panel A shows that post earnings announcements abnormal returns are significantly lower for all our categories, suggesting that both insiders and short sellers are able to make profitable trades after the news. Also in line with our conjectures, abnormal returns are significantly more negative faster in stocks where insiders and short sellers trade intensively together than for firms where both trade alone. In particular, abnormal returns in stocks with both insider and short sales (*Onloan&INsales*) are 7.5% lower than in stocks with *Low informed trading* at the first month after the announcement date (+20,+40), and continue to be lower after 2, 3 and 6 months. Stocks with *Only Onloan* are also significantly lower after the 1st month, but the magnitude of the adjustment is smaller relative to *Onloan&INsales*. In contrast, stocks with *Only INsales* are significantly lower only after the 2nd of the announcement date. Furthermore, *Lendable* is associated with lower future returns in all specifications. The significantly negative

coefficient in column 1 of Panel A indicates that a 1% increase in the relative stocks available to lend before the earnings announcement is associated with 4.5% reduction in the post-earnings abnormal returns.

The results in Panel B show even stronger support to our conjectures. In particular, while abnormal returns in *Onloan&INsales* stocks are 5.3% lower immediately after the announcement date, returns in stocks with *Only Onloan* and *Only INsales* start to be significantly lower at the 2nd and at the 3rd month, respectively. Overall, these results suggest that stock prices adjust significantly faster in stocks where both insiders and short sellers compete for trading than in stocks where they don't. Also, in line with Massa et al. (2015), stocks with higher short selling potential before the news, which we show in the previous section leads to higher competition, show lower future returns. We are able to extend their results by showing that in cases where short selling potential do not lead to competition, abnormal returns adjust slowly.

Importantly, the results in Table 3.4 show consistency with the theoretical predictions of (Back et al., 2000). That is, when insider and short sellers trade intensively in the same stocks (as in stock with *Onloan&INsales* stocks), they share the same opinion about those firm's value, therefore prices adjust faster than in cases where their opinions diverge (stocks with *Only Onloan* or *Only INsales*).

Next, we extend this analysis further and partition our sample by the direction of the news. For brevity purposes we only report results considering subsequent abnormal returns after day +5, but the results hold the same measuring returns after day +20. The results are reported in Table 3.5. Abnormal returns are significantly lower in stocks with intensive trading by both insider and short sellers (*Onloan&INsales*) irrespective of the direction of the news.

However, the strong price adjustment is concentrated mainly in stocks with positive and negative news, and in a minor level in stocks with no news. This suggests that when trading together insiders and short sellers trade in stocks with a strong market reaction to earnings announcement. Moreover, as future abnormal returns are significantly lower after both *GOOD* and *BAD* news, this result indicates that insiders and short sellers are likely to be trading in stocks that experience an overreaction to positive news and underreaction to negative news. Finally, in line with our predictions, abnormal returns are lower faster in stocks with *Onloan&INsales* than in stocks with *Only Onloan* or *Only INsales*) for both *GOOD news* and *BAD news* stocks.

Insert Table 3.5 about here.

3.3.4 Robustness and alternative explanations.

In the previous section we show that stock prices adjust faster in firms where insiders and short sellers trade intensively together, suggesting that they compete for trading on the same information. However, one could argue that the large price adjustment could be driven by the level of overpricing rather than by competition. In particular, if some firms become more overpriced, it's natural to expect that price correction should be stronger for these firms irrespective of whether insiders and short sellers trade intensively together or not. In contrast, if insiders and short sellers compete because they share similar private information (signal), then regardless of the level of mispricing, their trading together should lead to post earnings announcements abnormal returns being more negative sooner.

Controlling for different levels of overpricing is not simple, but we approach

the challenge in two ways. First, following Diether et al. (2009), we distinguish different levels of overpricing using the positive component of order imbalance shortly after the earnings news ($Oimb^{+}(0,+5)$). This measure captures temporary buying pressure: the larger the buying pressure the higher market sentiment and, therefore, the larger overpricing potential. Second, we take dispersion in analyst forecast derived from the Institutional Brokers Estimates System (I/B/E/S) as a measure of divergence in investors' opinions. Diether et al. (2002) show that stocks with higher dispersion in analysts' forecasts earn significantly lower future returns. This is because with high divergence in investors' opinions, stock prices reflect valuations of the most optimistic investors who push the demand for the stock up and so cause overpricing. By using both measures ($Oimb^{+}(0,+5)$ and $DISP$), we expect to find that the low future abnormal returns in firms where insiders and short sellers trade together sustain across different levels of $Oimb^{+}(0,+5)$ and $DISP$.

We compute $Oimb^{+}(0,+5)$ as the average buy order imbalance of a firm from day 0 to day 5 after the earnings announcements. Buy order imbalance is computed as the daily volume of buys scaled by the daily total volume.[13] In Panel A of Table 3.6 we show the distribution of post earnings announcement abnormal returns by quartiles of $Oimb^{+}(0,+5)$. We see that, future abnormal returns are consistently lower for higher levels of $Oimb^{+}(0,+5)$, except for the 1st quartile. This is because the first quartile of $Oimb^{+}(0,+5)$ contains stocks with the smallest buying pressure and, therefore, the selling pressure for these stocks is high, which is naturally associated with negative future abnormal returns.

In Panel B of Table 3.6 we regress post earnings announcements abnor-

[13]Buy and sells orders are defined using Lee and Ready (1991)

mal returns on our categorical variable for informed trading by quartiles of $Oimb^{+}(0,+5)$. The dependent variable is the cumulative abnormal returns from 5 until 46 days after the announcement and therefore this results are directly comparable to column (2) in Panel B of Table 3.4. The results confirm our conclusions in section 3.3.3. Abnormal returns are more negative in quarters where insiders and short sellers compete, and this is irrespective of the initial mispricing. In particular, abnormal returns are significantly more negative in *Onloan&INsales* quarters for quartiles 2, 3 and 4 of $Oimb^{+}(0,+5)$. Also, abnormal returns are negative, but insignificant for quartile 1, where stocks are less subject to overpricing. In contrast, the negative abnormal returns for *Only INsales* and *Only Onloan* are mainly concentrated at the highest $Oimb^{+}(0,+5)$ quartile, suggesting that the large price adjustment in firms with only insider sales or short sales is due to stocks that are more prone of overpricing.

Insert Table 3.6 about here.

Table 3.7 reports the results for dispersion in analysts' forecast (*DISP*). Panel A shows the distribution of post earnings announcement abnormal returns by quartiles of *DISP*. Although stocks in quartile 4 display lower future abnormal returns than the rest of the quartiles, the pattern is not monotonic as expected from the evidence of Diether et al. (2002). However, our results are not directy comparable to Diether et al. (2002) findings, as their setup is not based on earnings announcements and they take a monthly frequency of returns to test their predictions. In constrast, we take a much shorter term view when compounding returns which could diminish the possibility of getting the same results.

Insert Table 3.7 about here.

In addition, there are important disadvantages associated to the use dispersion in analysts' forecasts. First, small firms are generally not covered by many analysts, which might imply important biases of the measure. In fact, smaller firms suffer higher information asymmetries, thus, earnings announcements in smaller firms might be associated with stronger investors' reaction and divergence of opinions. And second, the measure does not allow to capture divergence in investors' opinions during the short window of earnings announcements. Analysts' forecasts reflect expectations concerning the earnings news and so the measure captures analysts' divergence before the earnings announcement rather than the effect on investors' disagreement as a result of the news publication. We are more interest in the latter rather than the former.

In spite of the drawbacks of using *DISP*, its disadvantages should lower our chances of finding a significant relationship between insiders' and short sellers' intensive trading and lower future returns. However, if this association holds even at different levels of *DISP*, it must be rather strong. The results in Panel B confirm these conjectures.[14] In particular, abnormal returns are more negative in quarters where insiders and short sellers trade together, and this holds for all the quartiles of *DISP* but the first.

[14]Note that the sample size shrinks significantly relative to the results in Panel B of Table 3.6.

3.4 Conclusions

We study the interation between 2 types of informed traders, corporate insiders and short sellers, around earnings announcements. For a quarterly sample of U.S. firms from 2006 until 2013, we test whether insiders and short sellers compete for trading on superior information processing of the news released in earnings announcements.

Our analysis has 4 branches. First, in line with the information processing hypothesis both insiders and short sellers trade intensively right after rather than before the earnings announcements date. Also, their trades are profitable as future stock returns are significantly lower. Second, insiders and short sellers sell intensively the same stocks shortly after the announcement date very frequently (around 29% of the firm-quarters in our sample). Consistent with the competition hypothesis (Massa et al., 2015), we show that high short selling potential before the earnings news significantly increases the likelihood of insiders and short sellers trading intensively in the same stocks. Moreover, low short selling potential is associated with a more monopolistic behavior of insiders. Third, also in line with the competition hypothesis, stock prices are significantly more negative faster in stocks with intensive insider and short selling, shortly after the news release, than in stocks with intensive trading by each type alone. Finally, we confirm that the large price adjustment in stocks with intensive insider and short selling is driven by competition rather than the level of overpricing.

Overall, our evidence shows that both insiders and short sellers make profitable trades based on analyzing publicly available information better than other investors. The 2 types of informed traders use their skills to interpret

new public information better and exploit situations when the market misintepret this information. Importantly, insiders and short sellers compete for trading on their superior information processing skills very frequently. As a result of the competition, stock prices adjust faster to their trades than in cases where they do not compete.

3.5 Appendix

Variable definitions

Variable	Definition	Source
BAD news	Dummy variable that is equal to 1 for all firm-quarters in the lowest (top) tercile of the 3-day earnings announcements abnormal return (EA abnormal returns) and 0 otherwise	CRSP, French's web site
B/M	Book value of equity corresponding to the previous quarter over the market cap 2 days before the earnings announcement.	COMPUSTAT
DISP	Dispersion of analysts' forecasts. Corresponds to the standard deviation of quarterly earnings per share (EPS) forecasts for the current earnings announcements that are issued in the period between the last earnings announcements and two days prior to the current earnings announcement date, divided by the absolute value of the median analyst forecast.	I/B/E/S
ΔEPS	Net earnings before extraordinary items per share less the earnings per share in the same quarter 1 year before scaled by the share price 2 days before the earnings announcements.	COMPUSTAT
EA abnormal returns	Buy and Hold abnormal stock return over 3 days around the last earnings announcement date $(-1, +1)$. The abnormal returns are estimated as the difference between the observed return and the returns of a benchmark at that date. The 4 factors model is used as a benchmark which take into account the market risk along with size and book to market risk factors (Fama and French, 1992), and also includes momentum as risk factor (Cahart, 1997).	CRSP, French's web site
GOOD news	Dummy variable that is equal to 1 for all firm-quarters in the top tercile of the 3-day earnings announcements abnormal return (EA abnormal returns) and 0 otherwise	CRSP, French's web site
INsales	Average number of shares sold by insiders scaled by the number of shares outstanding. INsales is averaged over the two informed trading response periods, namely (0,+5) and (0,+20)	Thomsom Financial
Lendable	Average daily number of shares available for lending before earnings announcements (trading days -30 to -3) scaled by the number of shares outstanding.	Markit(Dataexplorers).

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Variable	Definition	Source
Low informed trading	Category indicating a firm-quarter with low or no insider and short selling activity during the informed trading response period (see Figure 3.1). So, it's a firm-quarter with insider selling activity below the median of the number of shares sold by insider and with short selling activity in the bottom tercile of the number of shares shorted after an earning announcement.	Markit and Thomsom Financial
NO news	Dummy variable that is equal to 1 for all firm-quarters in the middle tercile of the 3-day earnings announcements abnormal return (EA abnormal returns) and 0 otherwise	CRSP, French's web site
$\text{Oimb}^{+}(0,+5)$	Daily buy order imbalance averaged over the informed trading response period between day 0 and day +5 after an earnings announcement. Buy order imbalance is computed as the daily buys scaled by the daily volume. Buy and sells orders are defined using Lee and Ready (1991).	TAQ data
Onloan	Average number of shares shorted within 1 business day scaled by the number of shares outstanding. Onloan is averaged over the two informed trading response periods, namely (0,+5) and (0,+20)	Markit
Onloan&INsales	Category indicating a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period (see Figure 3.1). It corresponds to a firm-quarter with short selling activity in the top 2 terciles and insider selling activity above the median of the number of shares traded by both types after an earning announcement.	Markit and Thomsom Financial
Only INsales	Category indicating a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period (see Figure 3.1). More specifically, it's a firm-quarter with insider selling activity above the median of the number of shares sold by insider and with short selling activity in the bottom tercile of the number of shares shorted after an earning announcement.	Markit and Thomsom Financial
Only Onloan	Category indicating a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period (see Figure 3.1). In particular, it's a firm-quarter with short selling activity in the 2 top terciles of the number of shares shorted and with insider selling activity below the median of the number of shares sold by insiders after an earning announcement.	Markit and Thomsom Financial

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Variable	Definition	Source
PastRET(6m)	Market adjusted stock return over 6 months ending 1 month before an earnings announcement. Returns are adjusted using the corresponding value weighted portfolio as downloaded from CRSP database.	CRSP, French's web site
PostBHAR(t_1,t_2)	The raw buy and hold stock return beginning t_1 and ending t_2 days after earnings announcement date adjusted for the corresponding 5x5 size and book to market portfolio return as downloaded from the Kenneth French web site or the market portfolio return.	CRSP, French's web site
Size	The logarithm of the Market capitalization. The market cap is the stock price times the number of shares outstanding 2 days before the earnings announcement date.	COMPUSTAT

Table 3.1: Distribution of insider sales and short sales in our sample per type of informed trading activity.

Distribution of trading activity for insiders and short sellers across all the firm quarters in our sample. In Panel A we consider trading activity from day 0 until 20 days after the earnings announcement date (0,+20), and in Panel B until 5 days (0,+5). *Onloan&Insales* is a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period. *Only Onloan* is a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period. *Only INsales* is a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period. *Low informed trading* is a firm-quarter with low or no insider and short selling activity during the informed trading response period.

	Firm quarters		Relative shares traded	
	# firm quarters	% of total	Insider sales	Short sales
Panel A: Trading activity from day 0 to day +20				
Onloan&INsales	29,062	28.5%	0.007%	0.220%
Only Onloan	41,296	40.4%	0.000%	0.197%
Only INsales	5,976	5.9%	0.006%	0.019%
Low informed trading	25,815	25.3%	0.000%	0.012%
Total	102,149			
Panel B: Trading activity from day 0 to day +5				
Onloan&INsales	14,921	14.6%	0.009%	0.221%
Only Onloan	55,426	54.3%	0.001%	0.198%
Only INsales	2,392	2.3%	0.007%	0.030%
Low informed trading	29,410	28.8%	0.001%	0.018%
Total	102,149			

Table 3.2: Average firm characteristic by type of informed trading activity.

This table reports summary statistics for all the firms in our sample and partitioned by our category of informed trading. The informed trading category is based on trading activity from day 0 until day +5. *Onloan&Insales* is a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period. *Only Onloan* is a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period. *Only INsales* is a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period. *Low informed trading* is a firm-quarter with low or no insider and short selling activity during the informed trading response period. All variables are defined in the Appendix.

Panel A: summary stats for all firms

Variables	# obs.	mean	standard dev.	p25	p50	p75
Onloan	102,149	0.149%	0.192%	0.025%	0.086%	0.196%
INsales	102,149	0.002%	0.008%	0.000%	0.000%	0.001%
Lendable	102,149	18.571%	12.098%	7.808%	18.796%	27.979%
Size (millions)	102,149	2,967.45	7,246.55	133.14	530.58	2,096.18
B/M	96,945	0.685	0.534	0.316	0.562	0.907
ΔEPS	101,759	-0.37%	8.05%	-0.82%	0.07%	0.71%
$\text{Oimb}^{+}(0,+5)$	100,746	8.63%	7.59%	3.57%	6.15%	11.06%
DISP	63,474	0.259	0.549	0.042	0.087	0.210
PastRET(6m)	102,149	0.01%	4.58%	-2.46%	-0.11%	2.38%
EA abnormal returns	102,149	0.142%	9.830%	-3.903%	-0.094%	3.862%
PostBHAR(+5,+25)	93,382	-0.512%	9.961%	-5.780%	-0.526%	4.543%
PostBHAR(+5,+46)	93,382	-0.390%	14.205%	-8.149%	-0.545%	6.913%
PostBHAR(+5,+67)	93,382	-0.659%	17.769%	-10.667%	-0.897%	8.635%
PostBHAR(+20,+40)	93,382	0.011%	10.151%	-5.432%	-0.176%	5.103%
PostBHAR(+20,+61)	93,382	-0.128%	14.448%	-8.027%	-0.299%	7.234%
PostBHAR(+20,+82)	93,382	-0.598%	18.140%	-10.830%	-0.847%	8.777%

Panel B: means by informed trading category

Variables	All firms	Onloan&Insales	Only Onloan	Only INsales	Low informed trading
Lendable	18.571%	26.297%	22.262%	15.007%	7.994%
Size (millions)	2,967.45	4,810.25	2,910.64	4,448.09	2,003.01
B/M	0.685	0.461	0.650	0.637	0.877
ΔEPS	-0.37%	0.22%	-0.50%	0.28%	-0.51%
$\text{Oimb}^{+}(0,+5)$	8.630%	5.633%	6.431%	10.909%	13.966%
DISP	0.259	0.201	0.271	0.183	0.305
PastRET(6m)	0.008%	1.264%	-0.084%	0.883%	-0.532%
EA abnormal returns	0.142%	2.295%	-0.432%	1.863%	-0.007%
PostBHAR(+5,+25)	-0.512%	-0.188%	-0.202%	-0.311%	-1.246%
PostBHAR(+5,+46)	-0.390%	0.207%	0.067%	0.117%	-1.560%
PostBHAR(+5,+67)	-0.659%	-0.016%	-0.275%	-0.277%	-1.693%
PostBHAR(+20,+40)	0.011%	0.463%	0.358%	0.254%	-0.880%
PostBHAR(+20,+61)	-0.128%	0.350%	0.151%	0.207%	-0.902%
PostBHAR(+20,+82)	-0.598%	0.096%	-0.310%	-0.225%	-1.484%

Table 3.3: Multinomial logistic regression: insider and short selling activity after earnings announcements.

This table reports a multinomial logistic regression of insiders and short sellers trading patterns right after an earnings announcement. The dependent variable is categorical variable based on short and insider selling intensity 5 days after the earnings announcement date. Hence, this variable is equals to 0 for a firm-quarter with low or no insider and short selling activity during the informed trading response period *Low informed trading*; is equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period *Onloan&INsales*, equals to 2 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period *Only Onloan*, and equals to 3 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period *Only INsales*. The remaining variables are defined in the Appendix. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

VARIABLES	Onloan&INsales		Only Onloan		Only INsales	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Lendable	1.920^{a}	(0.035)	1.510^{a}	(0.030)	0.772^{a}	(0.042)
BAD news	0.083^{b}	(0.035)	0.438^{a}	(0.026)	-0.292^{a}	(0.060)
GOOD news	0.710^{a}	(0.033)	0.294^{a}	(0.025)	0.328^{a}	(0.052)
Size	0.827^{a}	(0.037)	0.489^{a}	(0.030)	0.371^{a}	(0.040)
B/M	-0.790^{a}	(0.033)	-0.265^{a}	(0.019)	-0.226^{a}	(0.033)
PastRET(6m)	0.239^{a}	(0.015)	-0.037^{a}	(0.011)	0.196^{a}	(0.022)
ΔEPS	-0.020	(0.016)	-0.037^{a}	(0.011)	-0.003	(0.025)
Constant	-1.451^{a}	(0.057)	0.252^{a}	(0.041)	-1.633^{a}	(0.067)
# Observations	95,855					
Firm FE	yes					
Year FE	yes					
χ^2	9547					
PseudoR^2	0.243					
Average marginal effects on each outcome						
Lendable	0.121^{a}	(0.003)	0.073^{a}	(0.003)	-0.023^{a}	(0.002)
BAD news	-0.029^{a}	(0.004)	0.080^{a}	(0.004)	-0.021^{a}	(0.002)
GOOD news	0.039^{a}	(0.004)	-0.007^{a}	(0.004)	-0.001	(0.002)
Size	0.069^{a}	(0.003)	-0.005	(0.004)	0.003^{c}	(0.002)
B/M	-0.089^{a}	(0.004)	0.045^{a}	(0.004)	0.008^{a}	(0.001)
PastRET(6m)	0.035^{a}	(0.002)	-0.040^{a}	(0.002)	0.006^{a}	(0.001)
ΔEPS	0.004^{c}	(0.002)	-0.009^{a}	(0.002)	0.002^{b}	(0.001)

Table 3.4: Panel regressions: Post earnings announcement abnormal returns.

This table reports panel regressions of post earnings announcements abnormal returns on the trading activity of insiders and short sellers. The dependent variable for all columns is size and book to market adjusted abnormal returns. Panel A includes abnormal returns during subsequent returns period 2 and Panel B during period 1 (see Figure 3.1). Returns are adjusted for the corresponding 5x5 size and book to market portfolio return as downloaded from the Kenneth French web site. Abnormal returns are computed starting 5 days after the announcement date and cumulated over 1, 3 and 6 month later. *Onloan&INsales* is a dummy variable equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the corresponding trading response period ((0,+20) in Panel A and (0,+5) in Panel B)) and 0 otherwise. *Only Onloan* is a dummy variable equals to 1 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period ((0,+20) in Panel A and (0,+5) in Panel B)) and 0 otherwise. *Only INsales* is a dummy variable equals to 1 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period ((0,+20) in Panel A and (0,+5) in Panel B)) and 0 otherwise. GOOD (BAD) news is a dummy variable that is equal to 1 for all firm-quarters in the top (lowest) tercile of the 3-day earnings announcements abnormal return (window (-1,+1)) and 0 otherwise. *Lendable* is the average daily number of shares available for lending before earnings announcements (trading days -30 to -3) scaled by the number of shares outstanding. All variables are winsorized at the 1^{st} and 99^{th} percentiles. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

	Panel A: Future returns period 1			
VARIABLES	PostBHAR (+20,+40)	PostBHAR (+20,+61)	PostBHAR (+20,+82)	PostBHAR (+20,+145)
Onloan&INsales	-0.075^{a}	-0.131^{a}	-0.162^{a}	-0.232^{a}
	(0.013)	(0.013)	(0.013)	(0.014)
Only Onloan	-0.028^{a}	-0.067^{a}	-0.078^{a}	-0.124^{a}
	(0.011)	(0.011)	(0.011)	(0.011)
Only INsales	0.001	-0.047^{b}	-0.085^{a}	-0.119^{a}
	(0.019)	(0.020)	(0.020)	(0.021)
GOOD news	0.038^{a}	0.043^{a}	0.020^{b}	0.026^{a}
	(0.008)	(0.008)	(0.008)	(0.008)
BAD news	-0.013	-0.004	0.008	0.019^{b}
	(0.008)	(0.008)	(0.008)	(0.008)
Lendable	-0.045^{a}	-0.086^{a}	-0.117^{a}	-0.158^{a}
	(0.009)	(0.010)	(0.010)	(0.012)
Constant	-0.021	0.023^{c}	0.070^{a}	0.051^{a}
	(0.013)	(0.013)	(0.014)	(0.016)
Observations	92,913	92,913	92,913	92,913
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

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	Panel B: Future returns period 2			
Variables	PostBHAR (+5,+25)	PostBHAR (+5,+46)	PostBHAR (+5,+67)	PostBHAR (+5,+130)
Onloan&INsales	-0.052[a]	-0.096[a]	-0.153[a]	-0.215[a]
	(0.013)	(0.013)	(0.013)	(0.013)
Only Onloan	0.007	-0.032[a]	-0.065[a]	-0.106[a]
	(0.011)	(0.011)	(0.011)	(0.011)
Only INsales	-0.031	-0.028	-0.086[a]	-0.115[a]
	(0.020)	(0.019)	(0.020)	(0.020)
GOOD news	0.035[a]	0.049[a]	0.039[a]	0.034[a]
	(0.008)	(0.008)	(0.008)	(0.008)
BAD news	-0.043[a]	-0.035[a]	-0.011	0.001
	(0.008)	(0.008)	(0.008)	(0.008)
Lendable	-0.069[a]	-0.092[a]	-0.125[a]	-0.176[a]
	(0.009)	(0.010)	(0.010)	(0.012)
Constant	0.086[a]	0.032[b]	0.072[a]	0.073[a]
	(0.013)	(0.013)	(0.014)	(0.016)
Observations	92,913	92,913	92,913	92,913
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

Table 3.5: Panel regressions: Post-earnings announcement abnormal returns by earnings news.

This table reports panel regressions of post earnings announcements abnormal returns on the trading activity of insiders and short sellers. The dependent variable for all columns is size and book to market adjusted abnormal returns. Returns are adjusted for the corresponding 5x5 size and book to market portfolio return as downloaded from the Kenneth French web site or the market portfolio return. Abnormal returns are computed starting 5 days after the announcement date and cumulated over 1, 3 and 6 month later. *Onloan&INsales* is a dummy variable equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period (0,+5) and 0 otherwise. *Only Onloan* is a dummy variable equals to 1 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period (0,+5) and 0 otherwise. *Only INsales* is a dummy variable equals to 1 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period (0,+5) and 0 otherwise. GOOD (BAD) news is a dummy variable that is equal to 1 for all firm-quarters in the top (lowest) tercile of the 3-day earnings announcements abnormal return (window (-1,+1)) and 0 otherwise. *Lendable* is the average daily number of shares available for lending before earnings announcements (trading days -30 to -3) scaled by the number of shares outstanding. All variables are winsorized at the 1^{st} and 99^{th} percentiles. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

	GOOD news			NO news			BAD news		
VARIABLES	PostBHAR (+5,+25)	PostBHAR (+5,+46)	PostBHAR (+5,+67)	PostBHAR (+5,+25)	PostBHAR (+5,+46)	PostBHAR (+5,+67)	PostBHAR (+5,+25)	PostBHAR (+5,+46)	PostBHAR (+5,+67)
Onloan&INsales	-0.066^{a}	-0.123^{a}	-0.208^{a}	-0.036^{c}	-0.059^{a}	-0.079^{a}	-0.038	-0.089^{a}	-0.147^{a}
	(0.024)	(0.024)	(0.024)	(0.020)	(0.020)	(0.019)	(0.027)	(0.027)	(0.027)
Only Onloan	-0.028	-0.062^{a}	-0.124^{a}	0.001	-0.024	-0.037^{b}	0.030	-0.031	-0.050^{b}
	(0.022)	(0.021)	(0.021)	(0.016)	(0.017)	(0.016)	(0.022)	(0.022)	(0.021)
Only INsales	-0.011	0.011	-0.095^{a}	-0.050^{c}	-0.033	-0.069^{b}	-0.032	-0.069	-0.106^{b}
	(0.037)	(0.036)	(0.036)	(0.029)	(0.029)	(0.029)	(0.049)	(0.047)	(0.047)
Lendable	-0.077^{a}	-0.117^{a}	-0.158^{a}	-0.036^{b}	-0.053^{a}	-0.084^{a}	-0.089^{a}	-0.100^{a}	-0.126^{a}
	(0.016)	(0.017)	(0.018)	(0.016)	(0.016)	(0.017)	(0.018)	(0.018)	(0.019)
Constant	0.135^{a}	0.078^{a}	0.139^{a}	0.080^{a}	0.018	0.030	0.072^{a}	0.037	0.092^{a}
	(0.026)	(0.026)	(0.026)	(0.018)	(0.019)	(0.019)	(0.026)	(0.025)	(0.026)
Observations	30,969	30,969	30,969	30,878	30,878	30,878	31,066	31,066	31,066
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 3.6: Summary statistics and panel regression of post earnings returns on buy order imbalance.

This table reports an analysis of post earnings announcements abnormal returns conditional on different levels of buy order imbalance *Oimb^{+}(0,+5)*. Panel A displays the distribution of post earnings announcement abnormal returns by quartiles of *Oimb^{+}(0,+5)*. In Panel B we regress post earnings announcements abnormal returns on our categorical variable for informed trading by quartiles of *Oimb^{+}(0,+5)*. *Oimb^{+}(0,+5)* is the buy order imbalance of a firm averaged from day 0 to day 5 after the earnings announcement date. *Onloan&INsales* is a dummy variable equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period (0,+5) and 0 otherwise. *Only Onloan* is a dummy variable equals to 1 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period (0,+5) and 0 otherwise. *Only INsales* is a dummy variable equals to 1 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period (0,+5) and 0 otherwise. GOOD (BAD) news is a dummy variable that is equal to 1 for all firm-quarters in the top (lowest) tercile of the 3-day earnings announcements abnormal return (window (-1,+1)) and 0 otherwise. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

Panel A: Posterior return per Oimb quartiles

Oimb^{+}(0, +5)	PostBHAR(+5,+25)	PostBHAR(+5,+46)	PostBHAR(+5,+67)	PostBHAR(+5,+130)
quartile 1	-0.71%	-0.57%	-0.71%	-0.82%
quartile 2	-0.36%	-0.09%	-0.28%	-0.17%
quartile 3	-0.32%	-0.02%	-0.49%	-0.78%
quartile 4	-0.58%	-0.77%	-0.98%	-1.87%
Total	-0.49%	-0.36%	-0.61%	-0.90%

Panel B: Panel regressions for each Oimb^{+}(0,+5) quartile

	quartile 1	quartile 2	quartile 3	quartile 4
VARIABLES	PostBHAR(+5,+46)	PostBHAR(+5,+46)	PostBHAR(+5,+46)	PostBHAR(+5,+46)
Onloan&INsales	-0.017	-0.097^{a}	-0.092^{a}	-0.091^{a}
	(0.028)	(0.028)	(0.028)	(0.032)
Only Onloan	0.017	-0.042^{c}	-0.021	-0.054^{b}
	(0.025)	(0.025)	(0.023)	(0.023)
Only INsales	0.052	0.023	-0.002	-0.089^{b}
	(0.044)	(0.046)	(0.045)	(0.037)
BAD news	-0.018	-0.004	-0.027	-0.071^{a}
	(0.017)	(0.016)	(0.018)	(0.020)
GOOD news	0.036^{b}	0.045^{a}	0.023	0.090^{a}
	(0.017)	(0.016)	(0.017)	(0.018)
Lendable	-0.071^{a}	-0.066^{a}	-0.101^{a}	-0.156^{a}
	(0.021)	(0.020)	(0.020)	(0.026)
Constant	-0.008	0.033	0.016	-0.068^{b}
	(0.039)	(0.035)	(0.028)	(0.031)
Observations	23,282	23,405	22,631	21,815
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

Table 3.7: Summary statistics and panel regression of post earnings returns on dispersion in analysts' forecasts.

This table reports an analysis of post earnings announcements abnormal returns conditional on different levels of dispersion in analysts' forecasts (*DISP*). Panel A displays the distribution of post earnings announcement abnormal returns by quartiles of *DISP*. In Panel B we regress post earnings announcements abnormal returns on our categorical variable for informed trading by quartiles of *DISP*. *DISP* is the standard deviation of quarterly earnings per share (EPS) forecasts for the current earnings announcements that are issued in the period between the last earnings announcements and two days prior to the current earnings announcement date, divided by the absolute value of the median analyst forecast. *Onloan&INsales* is a dummy variable equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period (0,+5) and 0 otherwise. *Only Onloan* is a dummy variable equals to 1 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period (0,+5) and 0 otherwise. *Only INsales* is a dummy variable equals to 1 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period (0,+5) and 0 otherwise. GOOD (BAD) news is a dummy variable that is equal to 1 for all firm-quarters in the top (lowest) tercile of the 3-day earnings announcements abnormal return (window (-1,+1)) and 0 otherwise. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. Standard errors are reported in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the one-, five- and ten-percent levels.

Panel A: Posterior return per DISP quartiles

DISP	PostBHAR(+5,+25)	PostBHAR(+5,+46)	PostBHAR(+5,+67)	PostBHAR(+5,+130)
quartile 1	0.01%	0.27%	-0.11%	0.00%
quartile 2	-0.05%	0.22%	0.13%	0.42%
quartile 3	-0.19%	0.37%	0.50%	0.77%
quartile 4	-0.35%	0.01%	-0.37%	-0.46%
Total	-0.15%	0.22%	0.04%	0.18%

Panel B: Panel regressions on each DISP quartile

	quartile 1	quartile 2	quartile 3	quartile 4
Variables	PostBHAR(+5,+46)	PostBHAR(+5,+46)	PostBHAR(+5,+46)	PostBHAR(+5,+46)
Onloan&INsales	0.013	-0.069^{b}	-0.112^{a}	-0.112^{b}
	(0.023)	(0.031)	(0.035)	(0.043)
Only Onloan	0.014	-0.018	-0.038	-0.003
	(0.023)	(0.028)	(0.031)	(0.037)
Only INsales	-0.033	-0.034	0.015	0.018
	(0.032)	(0.049)	(0.057)	(0.079)
BAD news	0.002	0.000	-0.008	-0.054^{b}
	(0.015)	(0.019)	(0.022)	(0.026)
GOOD news	0.008	0.008	0.049^{b}	0.024
	(0.015)	(0.018)	(0.022)	(0.026)
Lendable	-0.059^{a}	-0.039^{c}	-0.102^{a}	-0.155^{a}
	(0.021)	(0.022)	(0.026)	(0.031)
Constant	0.016	0.055	0.062	0.024
	(0.024)	(0.035)	(0.043)	(0.056)
Observations	14,488	14,428	14,225	14,145
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

Figure 3.1: Timings of earnings announcements and related returns

The figure shows the exact timings of earnings announcements, informed trading response and related abnormal returns. We establish three important periods: (i) the earnings announcement period: the period beginning on day -1 and ending on day +1 working days, (ii) the informed trader response period: the period beginning on working day 0 and ending either after day +5 or +20. (iii) The subsequent return period: the period runs over day +5 up to day +130 or alternatively over +20 until +145.

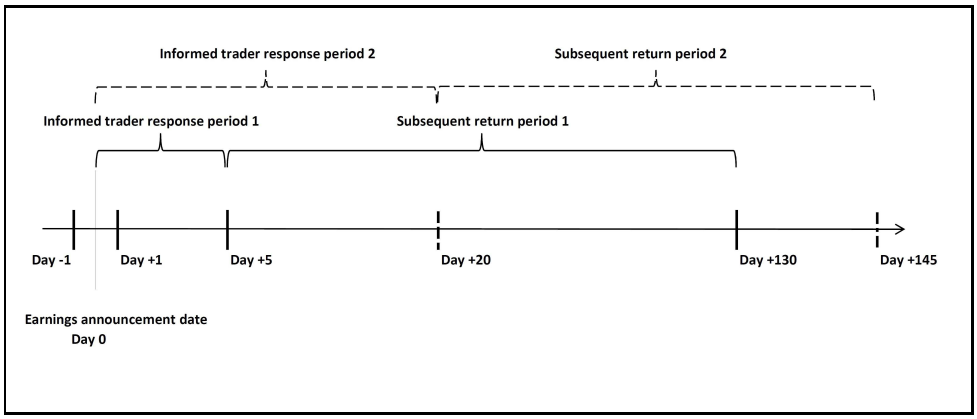


Figure 3.2: Daily shares sold by insiders and short sellers around earnings announcements.

The figure shows the number of shares sold by insiders (*INsales*) and the number of shares shorted (*Onloan*) around earnings announcements scaled by the number of shares outstanding.

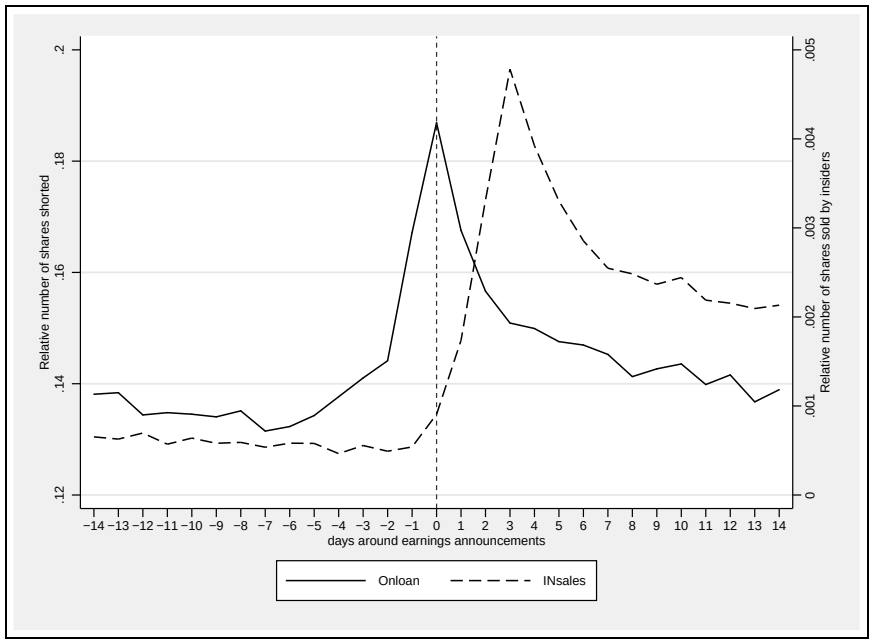


Figure 3.3: Daily shares sold by insiders and short sellers around earnings announcements categorized by earnings news.

The figure shows the number of shares sold by insiders (*INsales*) and the number of shares shorted (*Onloan*) around earnings announcements scaled by the number of shares outstanding. GOOD, BAD and NO news are firms with a 3-day earnings announcements abnormal return (window (-1,+1)) in the top, lowest and middle tercile of the returns for all the quarters respectively.

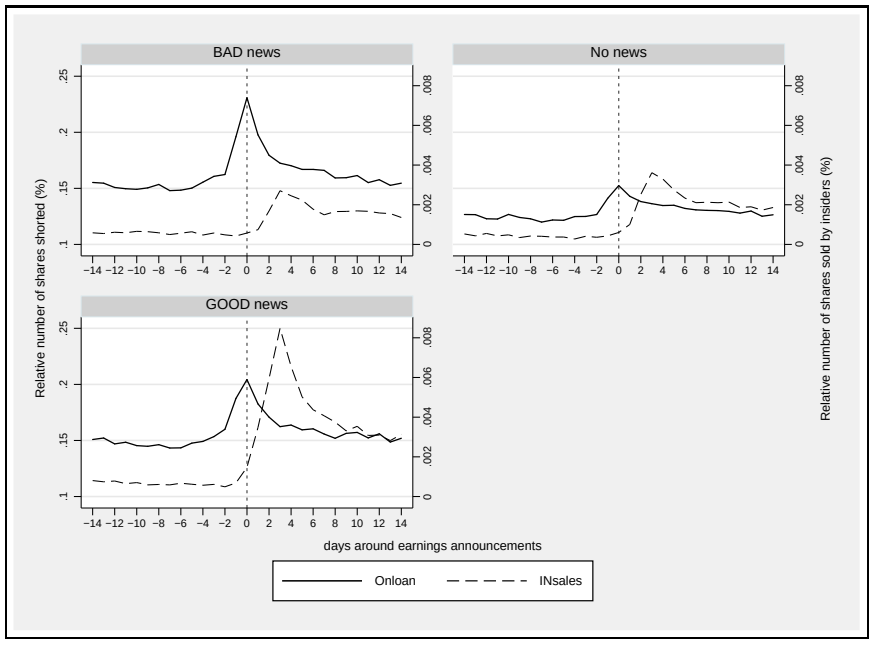
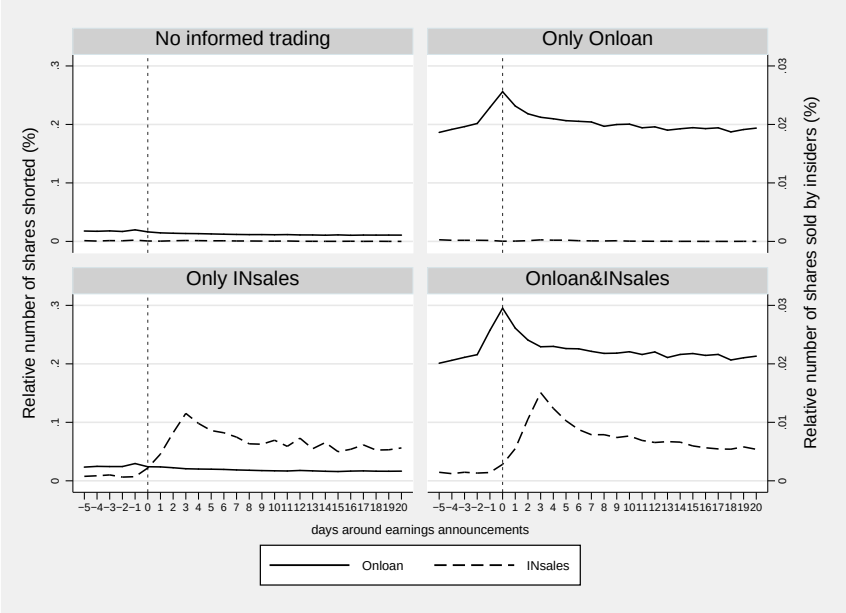


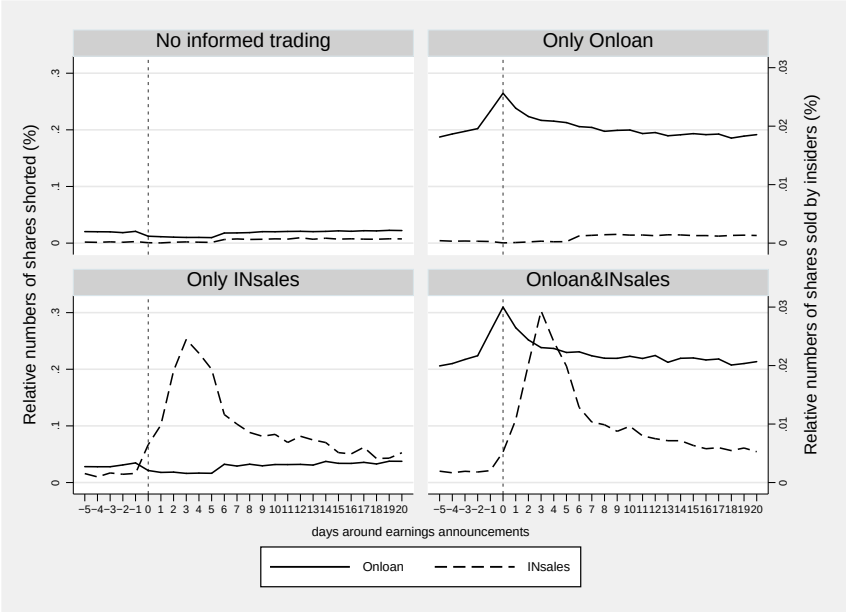
Figure 3.4: Daily shares sold by insiders and short sellers around earnings announcements categorized by informed trading type.

The figure shows the number of shares sold by insiders (*INsales*) and the number of shares shorted (*Onloan*) around earnings announcements scaled by the number of shares outstanding. *Onloan&INsales* is a firm-quarter with intensive short selling and insider selling activity during the informed trading response period (see Figure 3.1). *Only Onloan* is a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period. *Only INsales* is a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period. *Low informed trading* is a firm-quarter with low or no insider and short selling activity during the informed trading response period.

Panel A



Panel B



Concluding remarks

Corporate insiders are executives, directors and beneficial owners of more than 10% of the company stocks. Insiders know their companies better than any analyst in the market and therefore possess superior information about their firms' future performance. A large body of the literature question whether insider trading is harmful or beneficial for the financial markets. On the one hand, early studies show that insider trading increases informational efficiency of the market because it helps to incorporate private information into stock prices (Manne, 1966; Carlton and Fischel, 1983; Shin, 1996). On the other hand, insider transactions could crowd out information collection from outside investors and so deter the informational efficiency of the market (Fishman and Hagerty, 1992; Fernandes and Ferreira, 2009). Moreover, the literature also question which set of information insiders use when trading. One argument is that insiders trade on material information about future realization of their firm's cash flows (Noe, 1999; Ke et al., 2003; Piotroski and Roulstone, 2005; Cheng et al., 2007). In contrast, another argument is that insiders time very well their transactions and trade against current investor sentiment by recognizing when their stocks are mispriced by the market (Sivakumar and Waymire, 1994; Rozeff and Zaman, 1998; Jenter, 2005).

This thesis addresses these questions by focusing on insider trading strate-

gies around earnings announcements for a large sample of U.S. firms. The first chapter studies whether insiders exploit their stocks' mispricing to make profitable trades. We contribute to the literature by directly showing that insiders trade after earnings announcements on deviations of stock prices from their own perception of fundamental firm value rather than plainly against past returns or with book to market ratio. The analysis is twofold. First, insiders' purchases and sales are profitable both after positive and negative earnings surprises, which indicates that their trading strategies are superior to simple contrarian or momentum trading strategies. Second, we estimate a model of 'normal' market reaction to an earnings announcement and use the deviation of the fitted value from the realized market reaction as a measure of mispricing after earnings announcements. In line with the mispricing hypothesis, insiders sell (buy) more often after large positive (negative) values of our mispricing measure and earn significant post trading returns.

The second chapter shows evidence that insiders exploit investors' sentiment during earnings announcements to make profitable trades. Insiders sell in response to market reaction of earnings announcements that are associated with an increase in divergence in investors' opinions about their firms' valuation and more binding short sale constraints. We argue that this divergence in investors' opinions originates from investors' differential interpretations of the news contained in the earnings announcements. The evidence suggests that insiders sell in firms that are prone to become overvalued as a result of the earnings news.

Finally, the third chapter studies the interaction between 2 types of informed investors, corporate insiders and short sellers, after earnings announcements. The results show that insiders and short sellers are skilled information

processors who compete for trading on publicly available information. The 2 type of informed investors trade intensively in the same stocks very frequently (for about 29% of firm-quarters in the sample). In line with competition, stock returns are significantly more negative faster for stocks with intensive trading by both traders together than in cases where they trade intensively alone. This evidence suggests that insiders and short sellers tend to accelerate their processing skills after earnings announcements and trade faster making stock prices more efficient.

Overall, the evidence presented in the three chapters strongly indicates that a large portion of insiders' superior trading advantage comes from their ability to better process new information embedded in public news announcements. Insiders take advantage of situations when the market misinterpret the news and trade profitable. Processing this information for insiders is costless as they have privileged access to material information about their firms. Moreover, insider trading doesn't seem to deter information collection from market professionals, in contrast, the evidence in this thesis strongly suggests that insiders compete with other informed investors for trading on their superior information processing skills. As a result of this competition for trading on publicly available information, their trades allow information to be rapidly impounded into stock prices increasing market efficiency. On top of it, by trading on mispricing originated during earnings announcements insiders take advantage of market sentiment, trade profitable and at the same time minimize their own legal jeopardy.

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